Lower Duwamish Waterway Group

Port of Seattle / City of Seattle / King County / The Boeing Company

Lower Duwamish Waterway Remedial Investigation

DATA REPORT:

CHEMICAL ANALYSES OF BENTHIC INVERTEBRATE AND CLAM TISSUE SAMPLES AND CO-LOCATED SEDIMENT SAMPLES

FINAL

For submittal to

The US Environmental Protection Agency
Region 10
Seattle, WA

The Washington State Department of Ecology
Northwest Regional Office
Bellevue, WA

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Acronyms

Acronym	Definition
ACG	analytical concentration goal
Axys	Axys Analytical Services, Ltd.
Columbia	Columbia Analytical Services, Inc.
COC	chain of custody
CPUE	catch per unit effort
CSL	cleanup screening level
DMMP	Dredged Material Management Program
dw	dry weight
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
GPS	global positioning system
LCS	laboratory control sample

Acronym	Definition
LCSD	laboratory control sample duplicate
LDW	Lower Duwamish Waterway
MDL	method detection limit
ML	maximum limit
MHHW	mean higher high water
MLLW	mean lower low water
MS	matrix spike
MSD	matrix spike duplicate
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
ROC	receptor of concern
RL	reporting limit
RPD	relative percent difference
RSD	relative standard deviation
SDG	sample delivery group
SRM	standard reference material
SL	screening level
SOP	standard operating procedure
SQS	sediment quality standard
SRM	standard reference material
SVOC	semivolatile organic compound
TOC	total organic carbon
TBT	tributyltin
Windward	Windward Environmental LLC
ww	wet weight

1.0 Introduction

This data report presents the results of chemical analyses of benthic invertebrate tissue and co-located sediment samples collected as part of the Phase 2 Remedial Investigation for the Lower Duwamish Waterway (LDW). Sampling and analyses of these samples was conducted in accordance with the benthic invertebrate quality assurance project plan (QAPP) (Windward 2004b). Two types of benthic invertebrate tissue samples were collected and chemically analyzed (benthic invertebrate tissue and clam tissue). Benthic invertebrate community samples were also collected according to the benthic invertebrate QAPP. Results of the benthic community characterization effort are described in a separate report.

The composite samples of mixed benthic invertebrate taxa have been referred to as market basket samples in previous documents (Windward 2004b, d) because they represent the diversity of organisms available as prey. Data collected in this study will be used in the Phase 2 ecological risk assessment (ERA) for three purposes:

1. to assess the dietary exposure of receptors of concern (ROCs) that feed on the benthic community
2. to directly assess effects to benthic invertebrates from tributyltin (TBT) from a critical tissue residue approach
3. to develop accumulation factors to estimate chemical concentrations in benthic invertebrate tissue in areas where only sediment data have been collected

These data will also support the food web model, which will be used to link concentrations of one or more bioaccumulative, risk-driving chemicals in fish and crab tissue to concentrations of these chemicals in sediment and benthic invertebrate prey.

The clam study was designed to collect composite samples of clams and co-located sediment samples from LDW intertidal areas where clams could potentially be harvested by people and wildlife. The clam tissue data will be used in the Phase 2 risk assessments to estimate chemical exposures of people who could potentially consume clams collected from the LDW, and to estimate chemical exposures of otters and herons, which are wildlife ROCs that may consume clams as part of their diet. These data will also be used to evaluate the relationship between chemical concentrations in clams and sediment, and potentially as input to the food web model. The co-located sediment chemistry data will also be used in the Phase 2 risk assessments to estimate exposure of people and animals that may come in contact with intertidal sediments. Clams and co-located sediment were also collected from two background areas. These data will be used in an incremental risk analysis for arsenic in the human health risk assessment.

This report is organized into sections addressing field and analytical methods, chemical analysis results, and references. The text is supported by the following appendices:

- Appendix A – data tables
- Appendix B – data management
- Appendix C – data validation reports
- Appendix D - raw analytical laboratory data
- Appendix E – field forms and notes and laboratory forms
- Appendix F – chain-of-custody forms

Oversize figures are located following the main text. The text is also supported by a photo album documenting fieldwork activities and results, which can be viewed at: http://www.ldwg.org/Assets/BI/BI_fieldwork_album.htm.
The photo album is also available in compact disk format on request.

2.0 Benthic Invertebrate Tissue and Sediment Collection and Sample Processing Methods

This section briefly describes the collection of benthic invertebrate tissue samples and co-located sediment samples, as well as sample processing methods. The field procedures used to collect the benthic invertebrate samples and clam samples are described in detail in the QAPP (Windward 2004b). Tissue collection of benthic invertebrates and clams is described in two separate sections. Field deviations from the QAPP are also presented. Copies of completed chain-of-custody (COC) forms used to track sample custody are presented in Appendix F. Copies of field forms, notebooks, and laboratory forms are presented in Appendix E.

2.1 BENTHIC INVERTEBRATE COLLECTION

Benthic invertebrate tissue samples and co-located sediment samples were collected at both intertidal and subtidal locations in accordance with the QAPP and standardized procedures developed by the Puget Sound Estuary Program (EPA 2002a; PSEP 1997). This section briefly summarizes these methods.

2.1.1 Intertidal sampling

Benthic invertebrate tissue samples and co-located sediment samples were collected at 10 intertidal locations (Table 2-1, Figure 2-1 [oversized figure located following the main text]). At each intertidal location, samples were collected along three transects running perpendicular to the waterline between mean lower low water (MLLW) and mean higher high water (MHHW). Elevation was estimated to the nearest foot using

two staff gages, and the time was recorded on the field form (Table 2-2). Along each transect, five 0.1-m^2 stainless steel transect frames[1] were evenly spaced. Sediment from within each frame was sampled first for chemical analyses and then sieved for benthic invertebrate organisms. Table 2-2 summarizes collection information for each intertidal location, including sampling dates and times.

Table 2-1. Coordinates for intertidal benthic invertebrate sampling locations

Location	Transect Location [a]							
	Waterline				Upland			
	Latitude	Longitude	X	Y	Latitude	Longitude	X	Y
B1a	47 34.013	122 21.021	1265931	210473	47 34.012	122 21.030	1265894	210468
B2a	47 33.384	122 20.905	1266333	206641	47 33.393	122 20.893	1266383	206694
B3a	47 33.521	122 20.820	1266699	207466	47 33.518	122 20.834	1266641	207449
B4a	47 32.948	122 20.495	1267968	203957	47 32.949	122 20.499	1267952	203964
B5a-1[b]	47 32.352	122 19.882	1270420	200285	47 32.349	122 19.884	1270411	200267
B5a-2[b]	47 32.360	122 19.940	1270182	200308	47 32.352	122 19.939	1270185	200290
B6a	47 32.467	122 20.048	1269750	200998	47 32.444	122 20.055	1269719	200858
B7a	47 31.890[c]	122 19.150	1273379	197419	47 31.890[c]	122 19.150	1273379	197419
B8a	47 31.680	122 18.642	1275445	196102	47 31.683	122 18.644	1275437	196120
B9a	47 30.833	122 18.238	1277010	190922	47 30.839	122 18.221	1277081	190957
B10a	47 30.684	122 18.091	1277598	190005	47 30.683	122 18.077	1277656	189997

[a] Both geographic and state plane coordinates (WA State Plane N, US feet) based on NAD 83 horizontal datum. Coordinates for the center of the three transects are shown.

[b] Samples were collected at two locations at B5a. The first location (B5a-1) was inadvertently sampled 70 m from the target location. The second location (B5a-2) was sampled at the target location.

[c] The waterline and upland latitude coordinates were the same because the transect was very short.

Table 2-2. Collection information for intertidal benthic invertebrate samples

Location	Collection Date	Time	Estimated Transect Elevation Range[a] (ft MLLW)	Estimated Length of Primary Transect (m)	Distance Between Transects (m)	Number of 0.1^2-m Frames for Tissue Collection
B1a	8/12 and 8/13/04	1045 and 1000	0.0 to 6.5	11	10, 12	15
B2a	8/13/2004	1042	-0.5 to 4.5	19	10, 10	15
B3a	8/26/2004	0656	-1.0 to 4.0	20	10, 17	18[b]
B4a	8/14 and 8/15/04	1030 and 0930	-1.0 to 3.0	10	10, 10	15
B5a-1	8/16 and 8/27/04	1015 and 1005	1.5 to 4.1	10	10, 10	25[b]
B5a-2	9/24/2004	0720	0.5 to 5.5	14	8, 10	30[b]
B6a	8/15/2004	1105	-1.0 to 2.5	44	10, 10	15
B7a	8/30/2004	1135	-0.4 to -0.4	6	10, 10	15
B8a	8/17 and 8/27/04	1215 and 0815	0.9 to 0.9	10	10[c]	20[b]

[1] Each frame had the same surface area as the double van Veen grab samplers used in the subtidal.

Location	Collection Date	Time	Estimated Transect Elevation Range[a] (ft MLLW)	Estimated Length of Primary Transect (m)	Distance Between Transects (m)	Number of 0.1^2-m Frames for Tissue Collection
B9a	8/27/2004	0815	-1.7 to 1.7	26	10, 10	15
B10a	8/25 and 8/30/04	0645 and 1145	-1.0 to 2.0	18	10, 10	25[b]

[a] Estimated elevation of transect (waterline and upland) derived from either x,y coordinates and bathymetry map or tide table and sample time

[b] At intertidal locations with low abundance of benthic invertebrates, more than five frames were placed along each transect to ensure collection of sufficient tissue mass.

[c] Only two transects were sampled; the remaining 10 frames were collected in the upper reach of the intertidal area (see Section 2.6).

For sediment chemistry samples, approximately 200 mL of sediment was removed from within each frame from a depth of up to 10 cm using a stainless steel spoon. The sediment samples from all frames along each of the transects were placed in one stainless steel bowl for a total volume of at least 3 L of sediment from each intertidal location. The sediment was stirred with a clean, stainless steel spoon until textural and color homogeneity was achieved. The homogenized sediment was then split into four pre-labeled glass jars and stored on ice in a cooler. Excess sediment was returned to the sampling location.

Following collection of the sediment samples for chemical analysis, benthic invertebrates were collected from within each frame by digging the remaining sediment to a depth of approximately 10 cm. This sediment was transferred to stainless steel bowls and sieved through a 1-mm sieve. All organisms except mollusks or crustaceans larger than approximately 2 cm were retained for chemical analyses. These larger organisms, which could influence the chemical analysis disproportionately, were returned to the sampling location, as specified in the QAPP. The organisms retained for chemical analyses were placed in a glass jar with LDW water and stored on ice in a cooler. Photos from the intertidal field collection effort are presented in the benthic invertebrate fieldwork photo album.

2.1.2 Subtidal sampling

Benthic invertebrate tissue samples and co-located sediment samples were collected at 10 subtidal locations (Table 2-3, Figure 2-1 [oversized figure located following main text]). At each subtidal location, 10 acceptable grab samples were collected using a double van Veen grab sampler.[2] Coordinates for each grab are shown in Table 2-3. The retrieved van Veen grab samples were evaluated for acceptability in accordance with the QAPP.

[2] The double van Veen sampler collects two grab samples per cast at each sampling location. More than five casts were performed per location because not all ten grabs collected in the first five casts were acceptable. In addition, three of the grabs from three separate casts where both grabs were acceptable were used in the co-located taxonomic sample.

Table 2-3. Coordinates for subtidal benthic invertebrate sampling locations

Location	Sampling Location [a]				Location	Sampling Location [a]			
	Latitude	Longitude	X	Y		Latitude	Longitude	X	Y
B1b	47 34.068	122 20.933	1266300	210800	B6b	47 32.455	122 19.882	1270432	200911
	47 34.070	122 20.930	1266312	210812		47 32.453	122 19.882	1270432	200899
	47 34.070	122 20.928	1266320	210812		47 32.453	122 19.882	1270432	200899
	47 34.070	122 20.936	1266287	210813		47 32.453	122 19.882	1270432	200899
	47 34.070	122 20.936	1266287	210813		47 32.454	122 19.882	1270432	200905
	47 34.070	122 20.929	1266316	210812		47 32.456	122 19.881	1270436	200917
	47 34.070	122 20.936	1266287	210813		47 32.453	122 19.881	1270436	200899
B2b	47 33.456	122 20.647	1267403	207057	B7b	47 32.129	122 19.466	1272106	198897
	47 33.454	122 20.649	1267395	207045		47 32.129	122 19.470	1272089	198897
	47 33.455	122 20.649	1267395	207051		47 32.130	122 19.471	1272085	198903
	47 33.455	122 20.649	1267395	207051		47 32.130	122 19.466	1272106	198903
	47 33.456	122 20.649	1267395	207057		47 32.129	122 19.473	1272077	198897
	47 33.455	122 20.649	1267395	207051		47 32.130	122 19.469	1272094	198903
	47 33.455	122 20.648	1267399	207051		47 32.128	122 19.474	1272073	198891
B3b [b]	47 33.379	122 20.387	1268464	206568	B8b	47 31.134	122 18.339	1276629	192759
	47 33.379	122 20.387	1268464	206568		47 31.134	122 18.338	1276633	192759
	47 33.379	122 20.387	1268464	206568		47 31.135	122 18.337	1276638	192765
	47 33.379	122 20.387	1268464	206568		47 31.133	122 18.339	1276629	192753
	47 33.379	122 20.387	1268464	206568		47 31.134	122 18.337	1276637	192759
	47 33.379	122 20.392	1268443	206569		47 31.133	122 18.338	1276633	192753
	47 33.375	122 20.390	1268451	206544		47 31.133	122 18.338	1276633	192753
	47 33.376	122 20.390	1268451	206550	B9b	47 31.324	122 18.420	1276318	193921
	47 33.376	122 20.390	1268451	206550		47 31.325	122 18.423	1276306	193927
B4b	47 33.056	122 20.375	1268475	204604		47 31.323	122 18.419	1276322	193914
	47 33.056	122 20.376	1268470	204604		47 31.327	122 18.430	1276277	193940
	47 33.057	122 20.376	1268471	204610		47 31.326	122 18.433	1276265	193934
	47 33.056	122 20.375	1268475	204604		47 31.326	122 18.428	1276285	193933
	47 33.056	122 20.377	1268466	204604		47 31.326	122 18.427	1276289	193933
	47 33.057	122 20.376	1268471	204610	B10b	47 30.984	122 18.364	1276509	191850
	47 33.055	122 20.376	1268470	204598		47 30.984	122 18.364	1276509	191850
B5b	47 32.976	122 20.328	1268658	204114		47 30.984	122 18.365	1276505	191850
	47 32.977	122 20.329	1268654	204120		47 30.984	122 18.365	1276505	191850
	47 32.976	122 20.329	1268654	204114		47 30.984	122 18.364	1276509	191850
	47 32.974	122 20.327	1268662	204102		47 30.984	122 18.364	1276509	191850
	47 32.976	122 20.329	1268654	204114		47 30.985	122 18.364	1276509	191856
	47 32.976	122 20.329	1268654	204114					
	47 32.975	122 20.327	1268662	204108					
	47 32.975	122 20.328	1268658	204108					

[a] Both geographic and state plane coordinates (WA State Plane N, US feet) based on NAD 83 horizontal datum

[b] The latitude and longitude of many of the grabs at this location are identical because the boat was tied up. The grab sampler was moved around the outside of the boat, so samples were collected from slightly different locations from the boat in a fixed position.

After acceptance of each sample, the following observations were noted in the field logbook: GPS location, depth as read by the boat's depth sounder, gross characteristics of the surficial sediment, and maximum penetration depth. Table 2-4 summarizes collection information for each subtidal location, including sampling dates and times.

Table 2-4. Collection information for subtidal benthic invertebrate samples

Location	Collection Date	Time	Sediment Depth MLLW (m)	Penetration (cm)	Number of 0.1^2-m van Veen Grabs for Tissue Collection
B1b	9/27/04	0840-1230	-14.8 to -15.2	6-9	11[a]
B2b	9/27/04	1330-1540	-10.0 to -10.9	6-9	11[a]
B3b	8/10/04 8/17/04	1420-1540 1035-1245	- 2.4 to -4.2	8-13	10
B4b	9/28/04	0830-1122	-3.0 to -3.3	14-18	10
B5b	9/28/04	1225-1425	-0.9 to -1.8	6-12	10
B6b	8/18/04	1315-1640	-2.7to -4.2	11-15	10
B7b	8/13/04 8/17/04	1404-1650 0850-0930	-4.2 to -5.8	10-14	10
B8b	8/19/04	1245-1605	-0.3 to -1.5	14-15	10
B9b	8/11/04 8/13/04	1420-1450 0950-1300	-0.9 to -3.9	8-18	10
B10b	8/19/04	0835-1210	0.0 to -0.3	10-12	10

[a] Because the samples were collected with a double van Veen grab, additional acceptable grab samples became available for these locations. These additional samples were included in the composite samples to ensure sufficient tissue mass.

Each van Veen grab was sampled first for sediment chemical analyses and then sieved to collect benthic invertebrates. For sediment chemistry samples, approximately 200 mL of sediment was removed from within each grab from a depth of up to 10 cm using a stainless steel spoon. Sediment from all grab samples at a given subtidal location was placed in one stainless steel bowl for a total volume of at least 2 L of sediment from each subtidal location. The sediment was stirred with a clean stainless steel spoon until texture and color became homogeneous. The homogenized sediment was then split into four pre-labeled glass jars and stored on ice in a cooler. Excess sediment was returned to the sampling location.

Following collection of sediment samples for chemical analysis, benthic invertebrates were collected from the remaining sediment within each grab sample to a depth of approximately 10 cm. This sediment was sieved through a 1-mm sieve and all organisms except mollusks or crustaceans larger than approximately 2 cm were retained for chemical analyses. These larger organisms, which could influence chemical analyses disproportionately, were returned to the sampling location, as specified in the QAPP. The organisms retained for chemical analyses were placed in a glass jar with LDW water and stored on ice in a cooler. Photos from the subtidal field collection effort are presented in the benthic invertebrate fieldwork photo album.

2.2 BENTHIC INVERTEBRATE TISSUE SAMPLE PROCESSING

The benthic invertebrate tissue samples were transported to the Windward Environmental LLC (Windward) laboratory where each sample was sorted with pre-cleaned forceps into five major taxonomic groups (Annelida, Crustacea, Mollusca, Echinodermata, and miscellaneous phyla). Each group was weighed (wet weight [ww]) on a pre-tared, clean aluminum pan, and the groups from each sample were photographed. These photographs are included in the benthic invertebrate fieldwork photo album. Sample weights are shown in Table 2-5. After sorting and weighing, the organisms were then returned to a clean glass jar, refrigerated or stored on ice, and shipped overnight to Columbia Analytical Services, Inc. (Columbia).

Table 2-5. Weights (g ww) and percent of total weight of major taxonomic groups at each location

Location	Weight and (% of total weight)										Total Weight
	Annelida		Crustacea [a]		Mollusca [b]		Echinodermata		Misc. Phyla		
B1a	1.4	(11)	10.5	(79)	0.1	(0.75)	0.0	(0.0)	1.3	(9.8)	13.3
B2a	8.2	(44)	2.9	(16)	7.6	(41)	0.0	(0.0)	0.0	(0.0)	18.7
B3a	2.5	(18)	8.4	(61)	2.2	(16)	0.0	(0.0)	0.7	(5.1)	13.8
B4a	5.1	(24)	9.3	(43)	7.3	(34)	0.0	(0.0)	0.0	(0.0)	21.7
B5a-2	7.5	(64)	0.3	(2.6)	3.9	(33)	0.0	(0.0)	0.0	(0.0)	11.7
B6a	11.6	(59)	1.5	(7.7)	6.5	(33)	0.0	(0.0)	0.0	(0.0)	19.6
B7a	7.2	(39)	6.0	(32)	5.3	(29)	0.0	(0.0)	0.0	(0.0)	18.5
B8a	4.1	(26)	9.6	(61)	2.1	(13)	0.0	(0.0)	0.0	(0.0)	15.8
B9a	9.0	(40)	9.2	(41)	4.3	(19)	0.0	(0.0)	0.0	(0.0)	22.5
B10a	6.6	(44)	8.3	(56)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	14.9
B1b	7.4	(62)	1.6	(13)	2.0	(17)	0.0	(0.0)	1.0	(0.33)	12.0
B2b	9.5	(63)	0.2	(1.3)	2.6	(17)	0.0	(0.0)	2.7	(18)	15.0
B3b	12.3	(72)	0.7	(4.1)	1.0	(5.9)	0.0	(0.0)	3.0	(18)	17.0
B4b	26.7	(87)	2.5	(8.1)	0.0	(0.0)	0.0	(0.0)	1.6	(5.2)	30.8
B5b	17.9	(63)	0.1	(0.35)	3.9	(14)	0.0	(0.0)	6.3	(22)	28.2
B6b	11.9	(97)	0.1	(0.81)	0.2	(1.6)	0.0	(0.0)	0.1	(0.81)	12.3
B7b	15.6	(76)	0.3	(1.5)	4.5	(22)	0.0	(0.0)	0.1	(0.49)	20.5
B8b	20.5	(63)	5.0	(15)	6.7	(21)	0.0	(0.0)	0.3	(0.92)	32.5
B9b	4.8	(26)	9.3	(50)	4.6	(25)	0.0	(0.0)	0.0	(0.0)	18.7
B10b	3.0	(17)	14.5	(81)	0.5	(2.8)	0.0	(0.0)	0.0	(0.0)	18.0

[a] Crustaceans were predominantly *Corophium* sp.

[b] Mollusks were predominantly *Macoma baltica*

2.3 CLAM COLLECTION

Clam tissue samples and co-located sediment samples were collected at intertidal locations in the LDW and at two background areas in accordance with the QAPP. This section briefly summarizes the sampling methods.

2.3.1 LDW clam sampling

Clams were collected at 10 intertidal locations in the LDW during low tide following the catch per unit effort (CPUE) method used in 2003 (Windward 2004a) (Table 2-6, Figure 2-2 [oversized figure located following main text]). The method involved three field crew members actively searching and collecting clams from locations within the intertidal area with the highest clam abundance, as determined by evidence of siphon holes. The maximum level of effort for each of the 10 sampling locations was 2 hours for the three-person crew. Two composite clam tissue samples were collected at intertidal locations C2, C3, C7, and C10, and one composite clam tissue sample was collected at each of the remaining six locations. The collection effort of the two composited samples was guided by the length of the beach, the substrate (avoiding soft mud that made digging difficult), and the availability of clams on the beach. Each composite clam tissue sample consisted of at least 20 clams with shell widths of at least 2 cm (Table 2-7).

Table 2-6. Clam sampling location coordinates in the LDW

Location	Composite Sample	Clam Sampling Location [a, b]			
		Latitude	Longitude	X	Y
LDW-C1		47 33.991	122 21.008	1265982	210338
LDW-C2-1	1	47 33.546	122 20.845	1266599	207620
LDW-C2-2	2	47 33.452	122 20.792	1266806	207045
LDW-C3-1	1	47 33.582	122 21.010	1265925	207849
LDW-C3-2	2	47 33.569	122 21.007	1265935	207773
LDW-C4	1	47 32.955	122 20.498	1267956	204000
LDW-C5	1	47 32.711	122 20.182	1269228	202492
LDW-C6	1	47 32.464	122 20.064	1269684	200978
LDW-C7-1	1	47 32.129	122 19.151	1273401	198872
LDW-C7-2	2	47 32.174	122 19.124	1273517	199144
LDW-C8	1	47 32.224	122 19.132	1273492	199444
LDW-C9	1	47 32.036	122 19.392	1272400	198325
LDW-C10-1	1	47 31.612	122 18.648	1275412	195690
LDW-C10-2	2	47 31.602	122 18.636	1275461	195626

[a] Both geographic and state plane coordinates (WA State Plane N, US feet) based on NAD 83 horizontal datum

[b] GPS coordinates represent the approximate mid-point of each clam sampling location

Table 2-7. Collection information for LDW clam tissue samples

Sample	Collection Date	Time	# of Clams per Composite Sample
LDW-C1-T	8/26/04	0900-1000	25
LDW-C2-T1	8/26/04	0821-0855	32
LDW-C2-T2	8/26/04	0821-0855	52[a]
LDW-C3-T1	8/27/04	0945-1045	26
LDW-C3-T2	8/27/04	0945-1045	22

Sample	Collection Date	Time	# of Clams per Composite Sample
LDW-C4-T	8/27/04	0735-0815	22
LDW-C5-T	8/27/04	0845-0900	28
LDW-C6-T	8/25/04	0700-0730	22
LDW-C7-T1	8/26/04	0645-0735	20
LDW-C7-T2	8/26/04	0645-0735	22
LDW-C8-T	8/26/04	0850-0920	23
LDW-C9-T	8/25/04	0600-0650	22
LDW-C10-T1	8/25/04	0545-0930	21
LDW-C10-T2	8/25/04	0545-0930	19

[a] Additional clams were collected at this location to ensure sufficient tissue mass for the EPA split sample

The collection effort targeted siphon holes. At each clam tissue collection location, 50 mL from the first shovelful of sediment was collected for chemical analyses. The volume of the sediment was estimated using a 200 mL beaker. Holes were dug to a depth ranging from 15 to 60 cm to retrieve clams. Shovels were used to initiate the hole; in many cases, hand digging was required to retrieve clams without breaking shells. When an unbroken clam was collected, the sediment was retained and placed in a large stainless steel bowl; otherwise it was discarded. A minimum of twenty 50-mL sediment subsamples were composited into each 1-L sediment sample per location (except for one composite sample at C10a where 19 subsamples were collected). The sediment samples were homogenized to form a single composite sediment sample for that location, which was then placed into an appropriately sized glass jar and stored on ice in a cooler. Clams from each location were rinsed in site water, placed into 1-L glass or plastic jars, and stored on ice.

2.3.2 Background clam sampling

In addition to the clams collected in the LDW (as described in Section 2.3.1), clam tissue samples and co-located sediment samples were also collected from two background areas. Details of the background clam sampling effort are described in the fish and crab QAPP, along with the sampling design for the rest of the background tissue samples (Windward 2004c). The background clam tissue data are included in this data report for ease of comparison with the LDW clam tissue data.

Background sampling for clams took place on September 23 and 24, 2004 during negative low tides (-0.6 and -0.5 ft, respectively). Background locations were chosen based on the potential spatial influence of the former ASARCO smelter's aerial plume, the presence of suitable clam habitat and clams, and the absence of any known local sources of arsenic contamination (Figure 2-3 [oversized figure located following main text]). Fay Bainbridge State Park and Seahurst Park were selected as background sampling areas. Fay Bainbridge State Park is located at the northeastern side of Bainbridge Island, and is removed from the area believed to have been affected by the former ASARCO smelter's aerial plume. It is a popular public beach with a diverse

and abundant clam population. Seahurst Park in Burien is within the area believed to have been affected by the former ASARCO smelter's aerial plume, and is also a popular public beach with a moderately diverse clam population.

Six composite clam samples, consisting of approximately 20 clams each, were collected within each background area, using the methods described in Section 2.3.1 for LDW clam sampling. At each background sampling location, co-located sediment samples were also collected by the same methods used at the LDW clam sampling locations. Clams from each location within each background area were rinsed in site water, placed into 1-L glass or plastic jars, and stored on ice. Photos of composite samples of clams from each background area are presented in the benthic invertebrate fieldwork photo album.

The size of individual sampling locations within each background area varied widely, ranging from approximately 7 m^2 to 150 m^2, because of the patchy distribution of clams at each beach. However, each composite sampling location was unique and did not overlap with adjacent composite sampling locations. One composite sample was collected at each sampling location, with the exception of location SP-C-2, where four composite samples were collected. Clams at this beach were very patchy in distribution, so six different locations with sufficient clam abundance did not exist. The coordinates of each sampling location within each of the background areas are presented in Table 2-8. Table 2-9 presents the date and time of sampling and the number of clams represented in each composite tissue sample from the two background areas.

Table 2-8. Background clam sampling location coordinates

Location	Clam Sampling Location [a, b]			
	Latitude	Longitude	X	Y
BI-C-1	47 42.309	122 30.433	1228310	261699
BI-C-2	47 42.282	122 30.433	1228307	261535
BI-C-3	47 42.275	122 30.420	1228359	261491
BI-C-4	47 42.262	122 30.408	1228406	261411
BI-C-5	47 42.249	122 30.395	1228458	261331
BI-C-6	47 42.234	122 30.383	1228505	261239
SP-C-1	47 28.517	122 21.978	1261329	177145
SP-C-2[c]	47 28.605	122 21.897	1261673	177674
SP-C-6	47 28.625	122 21.897	1261675	177795

[a] Both geographic and state plane coordinates (WA State Plane N, US feet) based on NAD 83 horizontal datum

[b] GPS coordinates represent the approximate mid-point of each clam sampling location.

[C] Four composite clam samples were collected at this location.

Table 2-9. Collection information for background clam tissue samples

SAMPLE	COLLECTION DATE	TIME	# OF CLAMS PER COMPOSITE SAMPLE
BI-C-T1	9/23/2004	0700-0900	22
BI-C-T2	9/23 and 9/24/2004	0700-0900	28
BI-C-T3	9/23 and 9/24/2004	0700-0900	20
BI-C-T4	9/23 and 9/24/2004	0700-0900	22
BI-C-T5	9/23 and 9/24/2004	0700-0900	20
BI-C-T6	9/23/2004	0700-0900	21
SP-C-T1	9/23/2004	0700-0900	26
SP-C-T2	9/23/2004	0700-0900	24
SP-C-T3	9/23/2004	0700-0900	19
SP-C-T4	9/23/2004	0700-0900	21
SP-C-T5	9/23/2004	0700-0900	19
SP-C-T6	9/23/2004	0700-0900	20

2.4 CLAM SAMPLE PROCESSING

The clams were transported on ice in coolers to the Windward laboratory, where each clam was identified to species and its shell length at the longest point was measured and recorded. *Mya arenaria* was the primary species included in the composite clam tissue samples from the LDW, with only a few *Macoma nasuta* at locations C7 and C10. Six clam species, including *Saxidomus giganteus*, *Clinocardium nuttallii*, *Macoma nasuta*, *Macoma secta*, *Tresus capax*, and *Protothaca staminea* were identified from the two background areas, although not all six were found in each area. The dominant clam species found within the LDW, *Mya arenaria*, was not found in either background area. These findings are consistent with their preferred habitats; *M. arenaria* are typically found in brackish water environments, such as the LDW, whereas the other six species are more typical of marine environments. The clam species and average clam lengths at each LDW and background sampling location are presented in Tables 2-10 and 2-11, respectively. The species and lengths of individual clams are presented in full in Appendix A, Tables A-1 and A-2. After identification and measurement, clams were returned to the glass jars, stored on ice, and shipped overnight to Columbia for chemical analyses.

Table 2-10. Clam species and average clam lengths for each LDW sample

SAMPLE	SPECIES	AVERAGE LENGTH (cm)	NUMBER OF CLAMS
C1-T	*Mya arenaria*	5.9	25
C2-T1	*Mya arenaria*	5.1	32
C2-T2	*Mya arenaria*	7.7	52
C3-T1	*Mya arenaria*	6.8	26
C3-T2	*Mya arenaria*	7.3	22
C4-T	*Mya arenaria*	7.2	22

Sample	Species	Average Length (cm)	Number of Clams
C5-T	*Mya arenaria*	7.5	28
C6-T	*Mya arenaria*	7.4	22
C7-T1	*Mya arenaria*	7.4	17
	Macoma nasuta	2.3	3
C7-T2	*Mya arenaria*	6.8	22
C8-T	*Mya arenaria*	6.6	23
C9-T	*Mya arenaria*	7.9	22
C10-T1	*Mya arenaria*	7.1	19
	Macoma nasuta	2.2	2
C10-T2	*Mya arenaria*	7.0	17
	Macoma nasuta	2.2	2

Table 2-11. Clam species and average clam lengths for each background sample

Sample	Species	Average Length (cm)	Number of Clams
BI-C-T1	*Clinocardium nuttallii*	6.5	5
	Macoma nasuta	5.6	11
	Saxidomus giganteus	7.9	3
BI-C-T2	*Clinocardium nuttallii*	3.3	3
	Macoma nasuta	5.1	18
	Saxidomus giganteus	5.8	2
BI-C-T3	*Clinocardium nuttallii*	6.5	9
	Macoma nasuta	5.2	8
	Saxidomus giganteus	9.4	1
	Tresus capax	6.2	3
BI-C-T4	*Clinocardium nuttallii*	7.4	5
	Macoma nasuta	4.3	6
	Protothaca staminea	3.9	3
	Saxidomus giganteus	7.9	3
	Tresus capax	9.6	4
BI-C-T5	*Clinocardium nuttallii*	7.7	7
	Macoma nasuta	4.2	5
	Saxidomus giganteus	9.0	6
	Tresus capax	7.9	2
BI-C-T6	*Clinocardium nuttallii*	8.1	7
	Macoma nasuta	5.5	6
	Saxidomus giganteus	7.5	3
	Tresus capax	10.7	5

SAMPLE	SPECIES	AVERAGE LENGTH (cm)	NUMBER OF CLAMS
SP-C-T1	*Clinocardium nuttallii*	3.7	3
	Protothaca staminea	2.6	2
	Tresus capax	3.2	21
SP-C-T2	*Macoma secta*	6.1	24
SP-C-T3	*Macoma secta*	6.2	19
SP-C-T4	*Macoma secta*	6.0	21
SP-C-T5	*Macoma secta*	6.3	19
SP-C-T6	*Macoma secta*	5.3	19
	Macoma nasuta	3.2	1

BI – Fay Bainbridge State Park on Bainbridge Island

SP – Seahurst Park

2.5 SAMPLE IDENTIFICATION SCHEME

Each sampling location was assigned a unique alphanumeric location ID number. The first three characters of the location ID were "LDW" to identify the Lower Duwamish Waterway project area. The next characters indicated the type of samples collected (B or C). The locations designated with a B were sampled for benthic invertebrate tissue and co-located sediment. The locations designated with a C were sampled for clam tissue and co-located sediment. The letter B or C was followed by a number indicating the unique sampling location. These numbers range from 1 at the northernmost location to 10 at the southernmost location.

The type of sample was identified using an S suffix for sediment samples or a T suffix for tissue samples. Two clam and sediment samples were collected at locations C2, C3, C7, and C10; IDs for these samples included additional numeric suffixes as follows: S1 and S2 for sediment, and T1 and T2 for clams. Blanks were identified with a FB suffix (e.g., LDW-B7a-FB).

Samples from the clam background areas were designated either "BI" (for Fay Bainbridge State Park) or "SP" (for Seahurst Park), followed by a "C" (clam), and then either T1 through T6 for the six composite tissue samples or S1 through S6 for the six co-located sediment samples.

Examples of sample IDs are provided below:

- The composite benthic invertebrate tissue sample collected at intertidal location B7a was labeled LDW-B7a-T
- The composite surface sediment sample associated with the clam sampling location C9 was labeled LDW-C9-S

2.6 FIELD DEVIATIONS FROM THE QAPP

Field deviations from the QAPP included modifications to collection methods, dates, and locations. These field deviations did not affect the data quality and are discussed

in detail below. The US Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) were consulted on deviations that had a significant effect on study design.

- At two locations (B3a and B5a-2), the third transects had to be placed 8 m and 17 m, respectively, from the primary transect because of rocks covering the 10-m area.
- At location B8a, only two transects (instead of three) were placed between MLLW and MHHW because the very soft mud in the intertidal zone made sampling a larger area very difficult. Ten samples were collected along the two transects and on a later date an additional 10 individual samples were collected on a slightly more solid substrate near the top of the first transect.
- Collection of intertidal and subtidal benthic invertebrate samples was extended beyond August 9–20, 2004, the target sampling dates identified in the QAPP. The intertidal sampling effort was time-consuming because of very low benthic invertebrate abundances at the ten intertidal sampling areas. The effort was extended into minus tides on August 25–30 and September 24, 2004.
- Two subtidal locations (B1b and B2b) and one intertidal location (B3a) were resampled for both tissue and sediment on September 27, 2004 because Federal Express delivered the initial samples from these locations 48 hours late and the temperature in the cooler was outside the acceptable temperature range.
- Two subtidal locations (B4b and B5b) were resampled on September 28, 2004 because Columbia left the initial samples from these locations in the refrigerator beyond the holding time. Therefore, the field duplicate sediment sample collected with the original B5b sample had to be resampled. However, no field duplicate sediment sample was collected when location B5b was re-sampled on September 28th because of an oversight. In addition, no field duplicate sediment sample was collected during the clam sampling event because of an oversight. No duplicate tissue samples were specified in Section 3.5.1.2 of the QAPP. The lack of field duplicates for sediment did not result in any data validation qualifiers.
- Two sampling events occurred near or at intertidal location B5a. The first sampling event (B5a-1) was inadvertently conducted approximately 70 m from the target location presented in the QAPP. The second sampling event (B5a-2) was conducted at the target location. The benthic invertebrate tissue sample collected at B5a-1 was not analyzed because it was not collected from the target location; the sediment was analyzed for polychlorinated biphenyls (PCBs) and organochlorine pesticides.
- At four intertidal locations with low abundance of benthic invertebrates (B3a, B5a, B8a, and B10a), an additional 3 to 15 frames were placed along the transects in accessible areas that were outside of very soft mud areas, but that

had relatively high abundances of invertebrates, as indicated by holes in the sediment. Both benthic invertebrates and co-located sediments were collected from the additional frames. These invertebrates and sediments were combined with the invertebrates and sediments collected along the three transects either previously or on the same day.

- Two intertidal sampling locations (B7a and B9a) were moved approximately 145 m and 240 m, respectively, because limited beach area was exposed during a minus tide.
- Eleven van Veen grabs (rather than ten) were processed at B1b and B2b because two acceptable grabs were obtained from the last double van Veen cast, even though only one grab was needed to achieve the 10 grabs required by the QAPP. These samples were processed for tissue and sediment chemistry analyses because collection of sufficient tissue mass was a concern.
- The minimum benthic tissue mass of 20 g was not obtained at 14 of the 20[3] sampling locations, despite a level of effort at or beyond what was specified in the QAPP.
- Only 19 clams were collected in one of the replicate samples at locations C10-2, SP-3, and SP-5, although the target number was 20. However, sufficient mass was collected for chemical analysis at these three locations.
- The collection areas for the two samples at location C10 overlapped slightly because the highest abundance of clams was found in a relatively small part of the intertidal area with the highest PCB concentrations.
- Clam sampling at the two background areas took place in late September rather than earlier in the month to take advantage of lower negative tides.

3.0 Laboratory Methods

The methods and procedures used to chemically analyze the tissue and sediment samples are described briefly in this section and in detail in the benthic invertebrate QAPP (Windward 2004b). This section also summarizes any laboratory deviations from the QAPP.

Columbia homogenized and analyzed each benthic invertebrate and clam composite tissue sample,[4] analyzed the co-located sediment samples for most of the analytes, and shipped the splits of the appropriate samples to Brooks Rand and Axys. Brooks Rand analyzed the clam tissue samples for inorganic arsenic. Axys Analytical Services, Ltd. (Axys) will analyze a subset of the benthic invertebrate and clam tissue samples and a subset of the co-located sediment samples for all 209 PCB congeners (see Section 4.1).

[3] A mass of at least 20 g was collected at B4a, B9a, B4b, B5b, B7b, and B8b.
[4] The clams were shucked at Columbia.

The results from the PCB congener analyses will be included in an addendum to this data report.

3.1 TISSUE ANALYTICAL METHODS

Analytical testing adhered to the most recent EPA quality assurance and quality control guidelines and analysis protocols (EPA 2002a; PSEP 1997). The methods of chemical analysis are identified in Table 3-1. All methods selected represent standard methods used for the analysis of these analytes in tissue.

Table 3-1. Analytical methods for benthic invertebrate and clam tissue analyses

PARAMETER	UNIT	METHOD	REFERENCE
PCBs as Aroclors	µg/kg ww	GC/ECD	EPA 8082A
PCB congeners (archived frozen)[a]	ng/kg ww	HRGC/HRMS	EPA 1668
Organochlorine pesticides[b]	µg/kg ww	GC/ECD	EPA 8081A
SVOCs, including PAHs and alkylated PAH homologues[c]	µg/kg ww	GC/MS	EPA 8270 SIM
Arsenic (inorganic)[d]	mg/kg ww	HG-AFS	EPA 1632
Chromium	mg/kg ww	ICP-AES	EPA 6010
Mercury	mg/kg ww	CVAA	EPA 7471
Selenium	mg/kg ww	BHR-AA	EPA 7742
Other metals[e]	mg/kg ww	ICP-MS	EPA 6020
Butyltins (tetrabutyltin, tributyltin, dibutyltin and monobutyltin as ions)	µg/kg ww	GC/FPD	Stallard et al. (1988)
Lipids	% ww	gravimetric	NOAA (1993)
Moisture	% ww	freeze dried	PSEP (1997)

[a] All samples are being archived for potential analysis of PCB congeners and dioxins/furans

[b] A subset of samples was also analyzed by GC/MS (EPA 8270C-SIM)

[c] Alkylated PAH homologues were analyzed only in benthic invertebrates

[d] Only a subset of clam tissue samples were analyzed for inorganic arsenic. Eight of ten locations where clams were collected were randomly selected for inorganic arsenic analysis. At locations where more than one sample was collected, one of the two samples was randomly selected for inorganic arsenic analysis, yielding 8 samples in total. [e] Antimony, cadmium, cobalt, copper, lead, molybdenum, nickel, silver, thallium, vanadium, and zinc

BHR-AA – Borohydride reduction-atomic absorption

CVAA – cold vapor atomic absorption

GC/ECD – gas chromatography/electron capture detection

GC/FPD – gas chromatography/flame photometric detection

GC/MS – gas chromatography/mass spectrometry

HG-AFS – hydride generation-atomic fluorescence spectroscopy

HRGC/HRMS – high resolution gas chromatography/high resolution mass spectrometry

ICP-AES – inductively coupled plasma-atomic emission spectrometry

ICP-MS – inductively coupled plasma-mass spectrometry

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

SVOC – semivolatile organic compound

ww – wet weight

3.2 SEDIMENT ANALYTICAL METHODS

Analytical testing adhered to the most recent EPA quality assurance and quality control guidelines and analysis protocols (EPA 2002a; PSEP 1997). The methods of chemical analysis are identified in Table 3-2. All methods selected represent standard methods used for the analysis of these analytes in sediment.

Table 3-2. Analytical methods for sediment analyses

PARAMETER	UNIT	METHOD	REFERENCE
PCBs as Aroclors	µg/kg dw	GC/ECD	EPA 8082A
PCB congeners (archived frozen)[a]	ng/kg dw	HRGC/HRMS	EPA 1668
Organochlorine pesticides[b]	µg/kg dw	GC/ECD	EPA 8081A
SVOCs including PAHs[c]	µg/kg dw	GC/MS	EPA 8270C SIM
Mercury	mg/kg dw	CVAA	EPA 7471
Other metals[d]	mg/kg dw	ICP-MS	EPA 6020
Butyltins (tetrabutyltin, tributyltin, dibutyltin, and monobutyltin as ions)	µg/kg dw	GC/FPD	Stallard et al. (1988)
TOC	% dw	combustion	Plumb (1981)
Grain size	% dw	sieve/pipette	PSEP (1986)

[a] All samples are being archived for potential analysis of PCB congeners and dioxins/furans

[b] A subset of samples was also analyzed by GC/MS (EPA 8270C-SIM)

[c] Alkylated PAH homologues were analyzed only in sediments co-located with benthic invertebrates

[d] Antimony, arsenic, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc

CVAA – cold vapor atomic absorption

dw – dry weight

GC/ECD – gas chromatography/electron capture detection

GC/FPD – gas chromatography flame photometric detection

GC/MS – gas chromatography/mass spectrometry

HRGC/HRMS – high resolution gas chromatography/high resolution mass spectrometry

ICP-MS – inductively coupled plasma mass spectrometry

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

SIM – selected ion monitoring

SVOC – semivolatile organic compounds

TOC – total organic carbon

3.3 LABORATORY DEVIATIONS FROM THE QAPP

The laboratories followed the methods and procedures described in the QAPP with the following exceptions:

- When analyte concentrations were reported as not detected, the reporting limit was identified as the appropriate value in the electronic data delivery rather than the detection limit as specified in the QAPP. The method detection limit is used to establish the optimal sensitivity of the method. Method detection limits are established by analyzing a spiked clean sample and the MDL value is established through a statistical evaluation of the signal to noise ratio observed during the study. The reporting limit represents the lowest calibration point for the instrument on the day of sample analysis. This value reflects the sensitivity of the instrument on the day of analysis and the lower limit of the linear range of the calibration. Laboratories attempt to quantify analytes that are observed at concentrations between the MDL and the RL, however, the uncertainty associated with that value is large due to the fact that the concentration is below the calibration range of the instrument. Both detection limits and reporting limits are adjusted for sample dilution and the amount of sample extracted.
- The tissue sample volumes that were collected were discussed with EPA and Ecology and determined to be sufficient. However, matrix spikes were not run at the frequencies specified in the QAPP for benthic invertebrate tissue samples because of limited sample volumes (see Section 2.6).
- In the analysis of inorganic arsenic in tissue samples, no standard reference material (SRM) was analyzed because no tissue SRM with a certified value for inorganic arsenic was available
- In the analysis of metals in tissue samples, either an SRM or a laboratory control sample (LCS) was run with each sample delivery group (SDG). The QAPP required that both be run with each SDG.
- In addition to the GC/ECD analysis (EPA 8081A) for pesticides, a subset of sediment and tissue samples was selected for GC/MS-SIM (EPA 8279C-SIM) confirmation based on their total PCB and total DDT concentrations. Specifically, samples with sufficiently elevated concentrations of both PCBs and DDTs were re-analyzed using the GC/MS-SIM method to determine the concentrations of these chemicals without the interference that can occur between these chemicals using the GC/ECD method. The tissue samples were LDW-B5a-T and LDW-B8a-T. The sediment samples were LDW-B5a-S2, LDW-B8a-S, LDW-C7-S1, LDW C8-S, LDW C10-S1, and LDW-C10-S1. The results of the GC/MS-SIM analyses for these samples are included in this data report.
- Fifteen archived sediment samples (LDW-B1a-S, LDW-B2a-S, LDW-B3a-S, LDW-B10a-S, LDW-B1b-S, LDW-B8b-S, LDW-B9b-S, LDW-B10b-S, LDW-C2-S2, LDW-C3-S1, LDW-C3-S2, LDW-C4-S, LDW-C5-S, LDW-C6-S, and LDW-C9-S) were analyzed using GC/MS-SIM to achieve lower reporting limits (RLs) for comparison to Washington State Sediment Management Standards (SMS). Results from these analyses will be presented in an addendum to this data report with the PCB congener data.

4.0 Results of Chemical Analyses

Results of the tissue and sediment chemical analyses are summarized in this section. Complete data tables and raw laboratory data are presented in Appendices A and D, respectively. A detailed discussion of the approach used in averaging laboratory replicates is presented in Appendix B. Methods for calculating concentrations for total PCBs, total PAHs, and total DDTs are also presented in Appendix B. The number of significant figures shown for each concentration in all results tables in this section was specified by the analytical laboratory, as described in Appendix B. There was no additional manipulation of significant figures.

Quality assurance review of the chemistry data was conducted in accordance with the quality assurance/quality control (QA/QC) requirements and technical specifications of the methods, and the National Functional Guidelines for Organic and Inorganic Data Review (EPA 1999, 2002b). Laboratory Data Consultants (LDC) conducted the data validation. The results of the data validation are discussed in Section 4.3, and presented in full in Appendix C.

Explanations of data qualifiers (i.e., J) for specific analytes and sample groups are provided in Section 4.3. A detailed discussion of each qualified sample is provided in Appendix C.

4.1 Benthic Invertebrate Tissue and Co-located Sediment Results

Benthic invertebrate tissue samples were analyzed for metals, butyltins, semivolatile organic compounds (SVOCs), PCBs as Aroclors, organochlorine pesticides, percent moisture, and percent lipids. Co-located sediment samples were analyzed for metals, butyltins, SVOCs, PCBs as Aroclors, organochlorine pesticides, total solids, total organic carbon (TOC), and grain size.[5] The results of these analyses are discussed separately below under each analyte group.

Eight of the 20 co-located benthic invertebrate tissue and sediment samples are also being analyzed for PCB congeners by Axys. The eight locations are LDW-B1b, LDW-B2a, LDW-B3b, LDW-B4b, LDW-B5a, LDW-B8a, LDW-B9b, and LDW-B10a. These locations were selected, in consultation with EPA and Ecology, to provide PCB congener analyses over the range of total PCB concentrations in benthic invertebrate tissue samples (based on the PCB Aroclor results presented in Section 4.1.4), and to provide spatial coverage of locations within the LDW. The PCB congener concentrations in these samples will be reported in an addendum to this data report.

[5] The sediment sample collected at location B5a-1 was analyzed for PCBs as Aroclors, organochlorine pesticides, TOC, and total solids. The sediment sample collected at B5a-2 was analyzed for the standard analyte list.

4.1.1 Metals

The results from the metal analyses of benthic invertebrate tissue and co-located sediment samples are presented in Sections 4.1.1.1 and 4.1.1.2.

4.1.1.1 Benthic invertebrate tissue

Table 4-1 presents a summary of the metals analyzed in benthic invertebrate tissue samples, including the number of detections, the range of detected metals concentrations, and the range of reporting limits. Results for all metals in intertidal or subtidal benthic invertebrate tissue samples are presented in Tables 4-2 and 4-3, respectively, and also in Appendix A, Tables A-3 and A-4.

Table 4-1. Summary of metals concentrations in benthic invertebrate tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (mg/kg ww)	Maximum Detected Concentration (mg/kg ww)	Minimum Reporting Limit (mg/kg ww)	Maximum Reporting Limit (mg/kg ww)
Antimony	20/20	0.0013	0.172	na	na
Arsenic	20/20	0.573	17.4	na	na
Cadmium	20/20	0.0175 J	0.202 J	na	na
Chromium	20/20	0.08	3.90	na	na
Cobalt	20/20	0.0514 J	0.5520 J	na	na
Copper	20/20	1.94 J	21.8	na	na
Lead	20/20	0.143	14.60	na	na
Mercury	18/20	0.002	0.044	0.004	0.009
Molybdenum	20/20	0.0563	0.4330	na	na
Nickel	20/20	0.094	2.950	na	na
Selenium	20/20	0.055	0.603	na	na
Silver	20/20	0.0126 J	0.1650 J	na	na
Thallium	20/20	0.0006	0.0068	na	na
Vanadium	20/20	0.26	3.04	na	na
Zinc	20/20	8.22	43.6	na	na

Data qualifier: J - estimated concentration

na – not applicable

Table 4-2. Concentrations of metals (mg/kg ww) in intertidal benthic invertebrate tissue samples

ANALYTE	B1a	B2a	B3a	B4a	B5a-2[a]	B6a	B7a	B8a	B9a	B10a
Antimony	0.0074	0.0128	0.0031	0.0943	0.017	0.0354	0.0076	0.0107	0.0014	0.0057
Arsenic	0.623	1.820	0.915	2.450	1.770	1.710	0.923	0.788	0.947	0.809
Cadmium	0.0269 J	0.0361 J	0.0677 J	0.0377 J	0.055 J	0.0303 J	0.0308 J	0.0549	0.0211 J	0.0264
Chromium	0.08	0.27	0.18	0.18	2.80	0.41	3.90	0.31	0.27	0.23
Cobalt	0.0514 J	0.1510 J	0.1340 J	0.1370 J	0.3070	0.2920 J	0.1440 J	0.1280 J	0.1360 J	0.1070 J
Copper	4.38 J	3.04 J	7.86 J	9.28 J	21.8	3.85 J	3.50 J	4.37 J	2.61 J	4.82 J
Lead	0.506	0.488	0.179	0.519	2.260	1.560	14.60	0.532	0.182	0.409
Mercury	0.016	0.007	0.004 U	0.006	0.010	0.005	0.004	0.024	0.002	0.044
Molybdenum	0.0563	0.1440	0.0953	0.1420	0.1780	0.1870	0.1260	0.1010	0.0720	0.0667
Nickel	0.094	0.385	0.206	0.184	0.888	0.355	0.157	0.253 J	0.234	0.235 J
Selenium	0.085	0.179	0.148	0.150	0.214	0.178	0.120	0.089	0.092	0.092
Silver	0.0129 J	0.024 J	0.0346 J	0.0827 J	0.0333	0.0302 J	0.0268 J	0.165 J	0.0132 J	0.0202 J
Thallium	0.0006	0.0011	0.0021	0.0015	0.0028	0.0022	0.0010	0.0011	0.0015	0.0014
Vanadium	0.26	0.54	0.58	0.48	1.55	1.13	0.42	0.54	0.75	0.65
Zinc	8.22	17.5	17.4	27.7	31.6	43.6	25.7	22.9	12.9	10.3

[a] Tissue samples from location B5a-1 were not analyzed

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

Table 4-3. Concentrations of metals (mg/kg ww) in subtidal benthic invertebrate tissue samples

ANALYTE	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b
Antimony	0.019	0.029	0.172	0.0080	0.016	0.0061	0.0022	0.0049	0.0013	0.0046
Arsenic	1.40	1.32	17.4	1.89	1.12	4.45	3.07	1.99	0.573	0.843
Cadmium	0.172 J	0.202 J	0.103 J	0.072 J	0.048 J	0.0501	0.0424 J	0.0397	0.0175 J	0.0599
Chromium	2.66	1.32	1.93	1.82	0.84	1.08	1.20	0.59	0.15	0.28
Cobalt	0.3050	0.2130	0.5520 J	0.3710	0.1460	0.3400 J	0.3640 J	0.2280 J	0.0908 J	0.1290 J
Copper	20.6	15.5	13.2 J	19.2	10.3	4.78 J	5.10 J	5.25 J	1.94 J	9.05 J
Lead	1.390	1.410	4.700	2.390	0.821	1.810	1.030	0.217	0.143	0.202
Mercury	0.009	0.012	0.014	0.015	0.009 U	0.010	0.008	0.006	0.005	0.004
Molybdenum	0.4330	0.2490	0.4110	0.1760	0.1240	0.1350	0.1280	0.1210	0.0613	0.0758
Nickel	1.630	0.957	0.939	2.950	0.778	0.688 J	0.736	0.660 J	0.170	1.060 J
Selenium	0.603	0.434	0.323	0.358	0.263	0.368	0.328	0.153	0.055	0.086
Silver	0.073	0.112	0.0907 J	0.095	0.054	0.0427 J	0.0397 J	0.0295 J	0.0126 J	0.0279 J
Thallium	0.0032	0.0030	0.0049	0.0068	0.0024	0.0049	0.0056	0.0018	0.0009	0.0012
Vanadium	1.97	1.10	2.48	2.70	1.13	2.80	3.04	0.82	0.40	0.49
Zinc	14.4	20.7	42.3	19.6	26.4	21.7	15.7	19.7	9.55	11.1

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

Metals were detected in all intertidal and subtidal benthic invertebrate tissue samples and are described in more detail, as follows:

- All metals were detected in all benthic invertebrate tissue samples, except that mercury was not detected at the intertidal location B3a or the subtidal location B5b.
- The highest intertidal concentrations of metals were detected at the following locations: B3a—cadmium; B4a—antimony and arsenic; B5a-2—cobalt, copper, nickel, selenium, thallium, and vanadium; B6a—molybdenum and zinc; B7a—chromium and lead; B8a—silver; and B10a—mercury.
- The highest subtidal concentrations of metals were detected at the following locations: B1b—chromium, copper, molybdenum, and selenium; B2b—cadmium and silver; B3b—antimony, arsenic, cobalt, lead, and zinc; B4b—mercury, nickel, and thallium; and B7b—vanadium.

4.1.1.2 Sediment co-located with benthic invertebrate tissue samples

Table 4-4 summarizes the metals analyzed in the co-located sediment samples, including the number of detections, the range of detected concentrations, and the range of reporting limits.

Table 4-4. Summary of metals data in sediment samples co-located with benthic invertebrate tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (mg/kg dw)	Maximum Detected Concentration (mg/kg dw)	Minimum Reporting Limit (mg/kg dw)	Maximum Reporting Limit (mg/kg dw)
Antimony	20/20	0.09 J	122 J	na	na
Arsenic	20/20	3.90 J	725 J	na	na
Cadmium	20/20	0.066	1.67	na	na
Chromium	20/20	10.5	42.5	na	na
Cobalt	20/20	4.7	31.5	na	na
Copper	20/20	15.1	495	na	na
Lead	20/20	6.40 J	437 J	na	na
Mercury	20/20	0.025	0.528 J	na	na
Molybdenum	20/20	0.399	62.00	na	na
Nickel	20/20	6.70	24.8	na	na
Selenium	20/20	0.2	1.4	na	na
Silver	19/20	0.054 J	0.891	0.046	0.046
Thallium	19/20	0.036	0.236	0.032	0.032
Vanadium	20/20	27.7	72.6	na	na
Zinc	20/20	36.6	2,080	na	na

Data qualifier: J - estimated concentration

na – not applicable

Results for all metals detected in at least one intertidal or subtidal co-located sediment sample are presented in Tables 4-5 and 4-6, and compared to sediment quality standards (SQS) and cleanup screening levels (CSLs). For metals without SQS or CSL (antimony and nickel), concentrations are compared to screening levels (SL) and maximum levels (ML) from the Dredged Material Management Program. Concentrations in bold are above the respective SQS or SL. Bold underlined concentrations are above both the SQS or SL and the CSL or ML. The data are also presented in Appendix A, Tables A-5 and A-6. The frequency distributions for arsenic measured at intertidal and subtidal stations, and lead measured at intertidal stations are presented in Figures 4-1 and 4-2. The sampling locations were selected to characterize the concentrations of chemicals in benthic invertebrate tissues throughout the LDW over a range of chemical concentrations in sediment.

Metals were detected in all intertidal and subtidal co-located sediment samples and are described in more detail, as follows:

- All metals were detected in all sediment samples except for silver and thallium, which were not detected at the intertidal location B1a
- The mercury concentration in sediment from the intertidal location B8a exceeded the SQS
- The arsenic, copper and zinc concentrations in sediment from the subtidal location B3b exceeded the CSL

Table 4-5. Concentrations of metals (mg/kg dw) in sediment samples co-located with intertidal benthic invertebrate tissue samples compared to SQS/SL and CSL/ML

ANALYTE	B1a	B2a	B3a	B4a	B5a-2	B6a	B7a	B8a	B9a	B10a	SQS/SL	CSL/ML
Antimony [a]	1.05 J	0.57 J	0.16 J	20.3 J	0.74 J	0.90 J	0.26 J	1.68 J	0.20 J	1.72 J	150	200
Arsenic	3.90 J	9.34 J	5.77 J	46.5 J	7.41 J	5.26 J	6.56 J	7.89 J	6.63 J	9.23 J	57	93
Cadmium	0.066	0.204	0.109	0.323	0.296	0.140	0.176	0.693	0.206	0.118	5.1	6.7
Chromium	18.1	27.8	13.4	31.9	27.0	14.9	22.9	26.9	20.8	17.9	260	270
Cobalt	6.1	6.8	5.1	9.8	7.7	4.9	6.5	5.7	9.5	6.3	na	na
Copper	50.2	43.6	18.7	189	36.7	25.5	30.9	56.9	25.0	46.7	390	390
Lead	38.2 J	37.0 J	9.13	67.8 J	74.7	44.6 J	21.4 J	52.5 J	13.5	20.9 J	450	530
Mercury	0.079	0.085	0.025	0.115	0.160	0.059	0.060	**0.528 J**	0.110	0.060 J	0.41	0.59
Molybdenum	0.501	0.660	0.977	5.210	1.685 J	0.562	0.749	1.260	0.639	0.979	na	na
Nickel [a]	15.9	19.5	6.70	16.9	16.0	12.5	11.7	18.7	17.0	11.3	140	370
Selenium	0.2	0.9	0.7	0.7	0.3	0.5	0.6	0.9	0.7	0.6	na	na
Silver	0.046 U	0.267	0.086	0.545	0.168 J	0.088	0.139	0.257	0.122	0.090	6.1	6.1
Thallium	0.032 U	0.091	0.052	0.095	0.068	0.055	0.057	0.036	0.076	0.046	na	na
Vanadium	45.7	48.9	41.5	54.8	46.5	37.3	50.4	34.9	54.	50.7	na	na
Zinc	75.1	101	37.8	291	121	65.6	81.6	130	70.6	211	410	960

[a] No SQS or CSL is available; concentration in sediment is compared to SL and ML

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

Bold indicates concentration above the SQS or SL; na – neither SQS/SL nor CSL/ML is available

Table 4-6. Concentrations of metals (mg/kg dw) in sediment samples co-located with subtidal benthic invertebrate tissue samples compared to SQS/SL and CSL/ML

ANALYTE	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b	SQS/SL	CSL/ML
Antimony [a]	0.38 J	2.01 J	122 J	1.04 J	0.59 J	0.72 J	0.38 J	0.16 J	0.21 J	0.09 J	150	200
Arsenic	5.34 J	7.86 J	**725 J**	10.3 J	6.74 J	13.6 J	8.78 J	7.55 J	8.85 J	5.05 J	57	93
Cadmium	0.071	0.417	1.67	0.58	0.257	0.492	0.261	0.191	0.222	0.068	5.1	6.7
Chromium	10.5	24.6	42.5	37.7	20.3	33.8	32.7	24.5	25.1	16.1	260	270
Cobalt	4.7	8.7	31.5	12.0	7.1	11.2	9.4	8.6	9.1	6.9	na	na
Copper	15.1	54.9	**495**	86.6	42.0	80.8	39.6	32.7	31.0	17.2	390	390
Lead	17.5	44.6	437 J	79.4	30.8	40.9 J	23.3 J	12.7 J	19.0 J	6.4o J	450	530
Mercury	0.049	0.146	0.059	0.291	0.095	0.178	0.203	0.095	0.133	0.030	0.41	0.59
Molybdenum	0.543 J	0.625 J	62.00	1.010 J	1.080 J	0.731	0.472	0.505	0.770	0.399	na	na
Nickel [a]	7.00	16.2	22.9	24.8	14.0	23.8	18.4	17.3	15.6	11.4	140	370
Selenium	0.4	0.5	1.4	0.8	0.8	0.9	0.6	0.7	0.7	0.7	na	na
Silver	0.054 J	0.389 J	0.891	0.497 J	0.236 J	0.460	0.215	0.128	0.184	0.055	6.1	6.1
Thallium	0.060	0.096	0.236	0.151	0.092	0.121	0.108	0.073	0.069	0.040	na	na
Vanadium	27.7	47.9	47.8	72.5	43.3	70.7	72.6	60.9	62.7	46.1	na	na
Zinc	36.6	109	**2,080**	155	93.9	157	102	82.1	80.6	51.4	410	960

[a] No SQS or CSL is available; concentration in sediment is compared to SL and ML

Data qualifier: J - estimated concentration

Bold underlined indicates concentration above the CSL or ML

na – neither SQS/SL nor CSL/ML is available

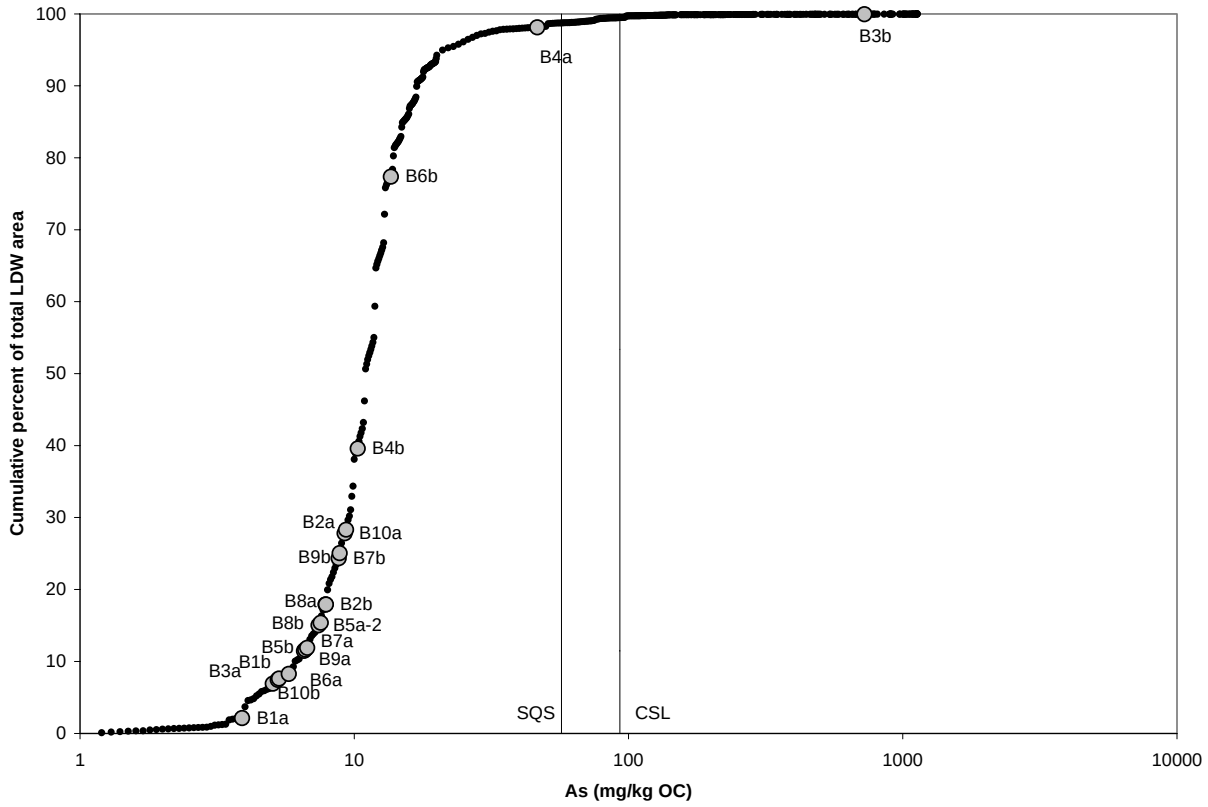

Figure 4-1. Cumulative frequency distribution of Phase I surface sediment arsenic concentrations in the LDW and measured sediment concentrations at intertidal and subtidal benthic invertebrate stations in Phase 2

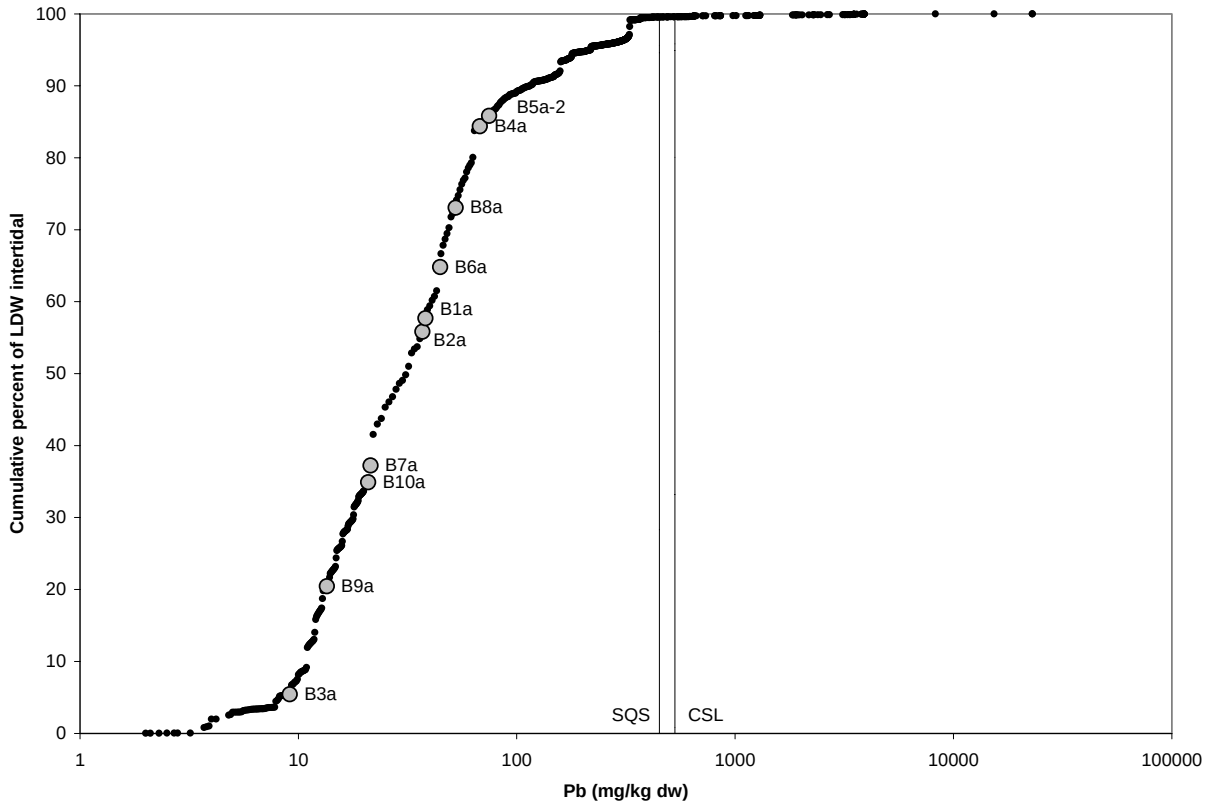

Figure 4-2. Cumulative frequency distribution of Phase I surface sediment lead concentrations in the LDW and measured sediment concentrations at intertidal benthic invertebrate stations in Phase 2

4.1.2 Butyltins

The results from the analyses of butyltins in intertidal and subtidal benthic invertebrate tissue and co-located sediment samples are presented in Sections 4.1.2.1 and 4.1.2.2.

4.1.2.1 Benthic invertebrate tissue

Table 4-7 presents a summary of the butyltins analyzed in benthic invertebrate tissue samples, including the number of detections, the range of detected butyltin concentrations, and the range of reporting limits. Results for all butyltins in intertidal and subtidal benthic invertebrate tissue samples are presented in Tables 4-8 and 4-9, respectively, and in Appendix A, Tables A-3 and A-4.

Tributyltin (TBT) was detected in all benthic invertebrate tissue samples, except the B1a intertidal tissue sample. The highest concentration of TBT in intertidal tissue samples was 30 µg/kg ww at locations B4a and B7a. In subtidal tissue samples, the highest TBT concentration was 92 µg/kg ww at location B1b.

Table 4-7. Summary of butyltin concentrations in benthic invertebrate tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
Monobutyltin as ion	9/20	2.4 J	30	4.6	9.4
Dibutyltin as ion	15/20	2.2 J	24	4.8	5.0
Tributyltin as ion	19/20	3.8 J	92	5.0	5.0
Tetrabutyltin as ion	0/20	nd	nd	1.6	11

Data qualifier: J - estimated concentration

na – not applicable

nd – not detected

Table 4-8. Concentrations of butyltins (µg/kg ww) in intertidal benthic invertebrate tissue samples

Analyte	B1A	B2A	B3A	B4A	B5A-2	B6A	B7A	B8A	B9A	B10A
Monobutyltin as ion	5.0 U	4.6 U	5.0 U	6.1	4.3 J	4.9 U	6.7 U	2.4 J	4.8 U	4.6 U
Dibutyltin as ion	5.0 U	6.6	4.0 J	8.9	4.6 J	3.6 J	6.1 J	2.2 J	4.8 U	2.5 J
Tributyltin as ion	5.0 U	27	12	30	22	15	30	18	7.4	3.8 J
Tetrabutyltin as ion	5.0 U	4.6 U	5.0 U	5.0 U	7.1 U	4.9 U	6.7 U	4.9 U	4.8 U	4.6 U

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

Table 4-9. Concentrations of butyltins (µg/kg ww) in subtidal benthic invertebrate tissue samples

Analyte	B1B	B2B	B3B	B4B	B5B	B6B	B7B	B8B	B9B	B10B
Monobutyltin as ion	30	8.5 J	6.5	8.5	4.1	9.4 U	4.7	4.9 U	4.9 U	5.0 U
Dibutyltin as ion	21	22	24	20	7.1	7.3 J	18	4.9 U	4.9 U	5.0 U
Tributyltin as ion	92	77	46	46	33	35	37	13	7.0	7.9
Tetrabutyltin as ion	11 U	8.9 U	5.0 U	1.6 U	2.4 U	9.4 U	4.5 U	4.9 U	4.9 U	5.0 U

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

4.1.2.2 Sediment samples co-located with benthic invertebrate tissue samples

Table 4-10 presents a summary of the butyltins analyzed in co-located sediment samples, including the number of detections, the range of detected butyltin concentrations, and the range of reporting limits. Results for all butyltins detected in the intertidal and subtidal co-located sediment samples are presented in Tables 4-11 and 4-12, respectively, and in Appendix A, Tables A-5 and A-6. The frequency distribution for TBT measured at intertidal and subtidal stations is presented in Figure 4-3. The frequency distribution shows that the stations represent a range of TBT concentrations.

TBT was detected in all sediment samples co-located with benthic invertebrate tissue samples. The highest TBT concentration in intertidal sediment samples was 32 µg/kg dw at location B4a. In subtidal sediment samples, the highest TBT concentration was 2,300 µg/kg dw at location B1b.

Table 4-10. Summary of butyltin concentrations in sediment samples co-located with benthic invertebrate tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw
Monobutyltin as ion	20/20	0.12 J	120	na	na
Dibutyltin as ion	20/20	0.39 J	360	na	na
Tributyltin as ion	20/20	0.35 J	2,300 J	na	na
Tetrabutyltin as ion	9/20	0.27 J	58	1.3	2.2

Data qualifier: J - estimated concentration

na – not applicable

Table 4-11. Concentrations of butyltins (µg/kg dw) in sediment samples co-located with intertidal benthic invertebrate tissue samples

Analyte	B1a	B2a	B3a	B4a	B5a-2	B6a	B7a	B8a	B9a	B10a
Monobutyltin as ion	0.27 J	8.6	0.12 J	4.9	5.2	1.1 J	2.5 J	8.3	1.2 J	1.2 J
Dibutyltin as ion	0.39 J	14	2.2	15	10	2.6	5.1	6.2	2.0	2.2
Tributyltin as ion	0.35 J	22	2.1	32	6.4	2.3	5.6	5.8	1.6 J	3.6
Tetrabutyltin as ion	1.3 U	0.56 J	1.6 U	0.74 J	1.6 U	1.4 U	2.0 U	1.9 U	1.9 U	1.6 U

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

Table 4-12. Concentrations of butyltins (µg/kg dw) in sediment samples co-located with subtidal benthic invertebrate tissue samples

Analyte	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b
Monobutyltin as ion	4.6 J	14	120	48	14	8.2	4.3	1.0 J	4.4	0.46 J
Dibutyltin as ion	130	26	360	44	18	12	8.7	1.4 J	10	1.7 J
Tributyltin as ion	2,300 J	63	320	96	30	20	13	1.7 J	6.7	2.3
Tetrabutyltin as ion	58	1.6	3.8 J	2.0 J	0.74 J	0.46 J	0.27 J	2.2 U	1.9 U	1.7 U

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

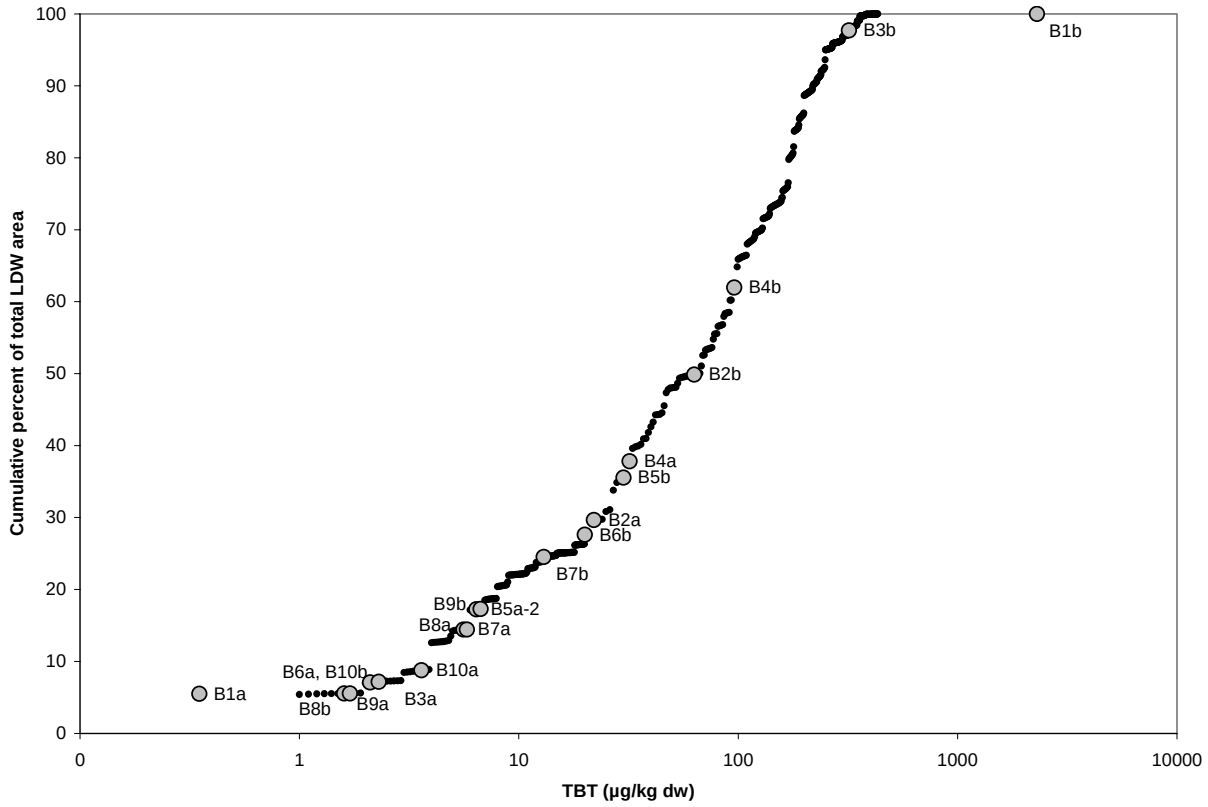

Figure 4-3. Cumulative frequency distribution of Phase I surface sediment TBT concentrations in the LDW and measured sediment concentrations at intertidal and subtidal benthic invertebrate stations in Phase 2

4.1.3 SVOCs

The results from the SVOC analyses of benthic invertebrate tissue and co-located sediment samples are presented in Sections 4.1.3.1 and 4.1.3.2.

4.1.3.1 Benthic invertebrate tissue

Table 4-13 presents a summary of the SVOCs analyzed in benthic invertebrate tissue samples, including the number of detections, the range of detected SVOC concentrations, and the range of reporting limits. Results for all SVOCs detected in at least one intertidal or subtidal benthic invertebrate tissue sample are presented in Table 4-14 and 4-15. The results are presented in full in Appendix A, Tables A-3 and A-4.

Table 4-13. Summary of SVOC concentrations in benthic invertebrate tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
PAHs					
1-Methylnaphthalene	19/20	0.75 J	5.0 J	50	50
2-Chloronaphthalene	0/20	nd	nd	200	400
2-Methylnaphthalene	20/20	1.0 J	5.6 J	na	na
Acenaphthene	20/20	0.61 J	35	na	na
Acenaphthylene	19/20	0.40 J	12 J	25	25
Anthracene	20/20	1.0 J	110	na	na
Benzo(a)anthracene	20/20	0.93 J	270	na	na
Benzo(a)pyrene	17/20	2.0 J	190	25	25
Benzo(b)fluoranthene	20/20	1.5 J	290	na	na
Benzo(e)pyrene	20/20	3.8 J	250	na	na
Benzo(g,h,i)perylene	20/20	1.1 J	88	na	na
Benzo(k)fluoranthene	20/20	1.6 J	220	na	na
Total benzofluoranthenes (calc'd)[a]	20/20	3.4 J	510	na	na
Chrysene	20/20	8.2 J	780	na	na
Dibenzo(a,h)anthracene	15/20	0.61 J	25 J	25	25
Dibenzofuran	19/20	0.72 J	32	25	25
Fluoranthene	20/20	10 J	680	na	na
Fluorene	20/20	0.83 J	57	na	na
Indeno(1,2,3-cd)pyrene	19/20	0.80 J	87	25	25
Naphthalene	20/20	3.4 J	7.3 J	na	na
Perylene	13/20	3.2 J	69	25	25
Phenanthrene	20/20	3.7 J	320	na	na
Pyrene	20/20	11 J	570	na	na
Total HPAH (calc'd)[a]	20/20	36 J	3,200 J	na	na
Total LPAH (calc'd)[a]	20/20	12.4 J	450 J	na	na
Alkylated-PAHs					
C1-Chrysenes	5/20	36 J*	240 J*	25	50
C1-Dibenzothiophenes	1/20	46 J*	46 J*	25	50
C1-Fluoranthene/Pyrene	12/20	39 J*	560 J*	25	46
C1-Fluorenes	2/20	34 J*	39 J*	25	50
C1-Phenanthrenes/Anthracenes	7/20	26 J*	140 J*	25	50
C2-Chrysenes	1/20	140 J*	140 J*	25	50
C2-Dibenzothiophenes	1/20	36 J*	36 J*	25	50
C2-Fluorenes	4/20	36 J*	84 J*	25	50
C2-Naphthalenes	1/20	68 J*	68 J*	25	50
C2-Phenanthrenes/Anthracenes	6/20	28 J*	110 J*	25	50
C3-Chrysenes	0/20	nd	nd	25	50
C3-Dibenzothiophenes	0/20	nd	nd	25	50

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
C3-Fluorenes	4/20	37 J*	92 J*	25	50
C3-Naphthalenes	1/20	120 J*	120 J*	25	50
C3-Phenanthrenes/Anthracenes	7/20	35 J*	71 J*	25	50
C4-Chrysenes	0/20	nd	nd	25	50
C4-Naphthalenes	1/20	110 J*	110 J*	25	50
C4-Phenanthrenes/Anthracenes	4/20	29 J*	55 J*	25	50
Phthalates					
Bis(2-ethylhexyl)phthalate	5/20	1,100 J	2,200 J	2,500	2,500
Butyl benzyl phthalate	1/20	190 J	190 J	200	400
Diethyl phthalate	0/20	nd	nd	390	790
Dimethyl phthalate	0/20	nd	nd	200	400
Di-n-butyl phthalate	0/20	nd	nd	200	400
Di-n-octyl phthalate	0/20	nd	nd	200	400
Other SVOCs					
1,2-Dichlorobenzene	0/20	nd	nd	200	400
1,3-Dichlorobenzene	0/20	nd	nd	200	400
1,4-Dichlorobenzene	0/20	nd	nd	200	400
1,2,4-trichlorobenzene	0/20	nd	nd	200	400
2,4,5-Trichlorophenol	1/20	75 J	75 J	390	790
2,4,6-Trichlorophenol	1/20	47 J	47 J	390	790
2,4-Dichlorophenol	0/20	nd	nd	390	790
2,4-Dimethylphenol	1/20	71 J	71 J	390	790
2,4-Dinitrophenol	0/20	nd	nd	3,900	7,900
2,4-Dinitrotoluene	0/20	nd	nd	390	790
2,6-Dinitrotoluene	0/20	nd	nd	200	400
2-Chlorophenol	0/20	nd	nd	390	790
2-Methylphenol	0/20	nd	nd	390	790
2-Nitroaniline	0/20	nd	nd	970	2,000
2-Nitrophenol	0/20	nd	nd	200	400
3,3'-Dichlorobenzidine	0/20	nd	nd	9,700	20,000
3-Nitroaniline	0/20	nd	nd	2,000	4,000
4,6-Dinitro-o-cresol	0/20	nd	nd	2,000	4,000
4-Bromophenyl phenyl ether	0/20	nd	nd	200	400
4-Chloro-3-methylphenol	0/20	nd	nd	970	2,000
4-Chloroaniline	1/20	53 J	53 J	970	2,000
4-Chlorophenyl phenyl ether	0/20	nd	nd	200	400
4-Methylphenol	6/20	77 J	44,000	400	790
4-Nitroaniline	0/20	nd	nd	970	2,000
4-Nitrophenol	2/20	280 J	2,300 J	2,000	4,000
Aniline	0/20	nd	nd	3,900	7,900
Benzidine	0/20	nd	nd	25,000	50,000
Benzoic acid	19/20	990 J	14,000	4,000	4,000
Benzyl alcohol	8/20	57 J	1,100	200	400

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
Biphenyl	20/20	1.4 J	5.3 J	na	na
bis(2-chloroethoxy)methane	0/20	nd	nd	200	400
bis(2-chloroethyl)ether	0/20	nd	nd	200	400
bis(2-chloroisopropyl)ether	0/20	nd	nd	200	400
Carbazole	0/20	nd	nd	970	2,000
Dibenzothiophene	15/20	0.69 J	26	25	50
Hexachlorobenzene	0/20	nd	nd	9.7	18
Hexachlorobutadiene	0/20	nd	nd	200	400
Hexachlorocyclopentadiene	0/20	nd	nd	25,000	50,000
Hexachloroethane	0/20	nd	nd	200	400
Isophorone	0/20	nd	nd	200	400
Nitrobenzene	0/20	nd	nd	200	400
N-Nitrosodimethylamine	0/20	nd	nd	200	400
N-Nitroso-di-n-propylamine	1/20	3,700	3,700	200	2,300
N-Nitrosodiphenylamine	1/20	170 J	170 J	200	400
Pentachlorophenol	5/20	1,100 J	4,700	2,000	4,000
Phenol	9/20	91 J	580	99	990

[a] Totals were calculated following rules described in Appendix B

Data qualifier: J - estimated concentration; J* - Alkylated PAHs were analyzed by the method specified in the QAPP. The validation review did not result in qualification. The EPA QA office requested the J qualification based on the use of parent compound response factors to quantify the alkylated compounds.

na – not applicable

nd – not detected

Table 4-14. Concentrations of SVOCs (µg/kg ww) detected in at least one intertidal benthic invertebrate tissue sample

ANALYTE	B1a	B2a	B3a	B4a	B5a	B6a	B7a	B8a	B9a	B10a
PAHs										
1-Methylnaphthalene	1.9 J	1.6 J	1.2 J	1.5 J	2.4 J	2.4 J	5.0 J	3.3 J	1.4 J	1.2 J
2-Methylnaphthalene	2.3 J	2.1 J	1.3 J	1.7 J	3.0 J	2.7 J	5.6 J	2.9 J	1.5 J	1.3 J
Acenaphthene	2.3 J	2.6 J	1.4 J	2.5 J	2.8 J	22 J	4.0 J	35	2.0 J	0.95 J
Acenaphthylene	0.81 J	2.1 J	0.54 J	2.3 J	1.6 J	2.6 J	3.8 J	1.6 J	25 U	0.40 J
Anthracene	2.6 J	6.4 J	1.7 J	5.8 J	4.7 J	30	6.5 J	32	1.4 J	1.0 J
Benzo(a)anthracene	2.1 J	21 J	3.3 J	16 J	12 J	59	16 J	41	3.9 J	0.93 J
Benzo(a)pyrene	2.3 J	12 J	25 U	12 J	4.1 J	10 J	6.8 J	9.3 J	2.0 J	25 U
Benzo(b)fluoranthene	3.3 J	23 J	2.1 J	18 J	6.1 J	18 J	13 J	13 J	2.4 J	1.5 J
Benzo(e)pyrene	12 J	23 J	6.8 J	19 J	6.7 J	17 J	15 J	13 J	5.7 J	3.8 J
Benzo(g,h,i)perylene	2.9 J	7.5 J	1.1 J	9.8 J	3.5 J	4.1 J	6.0 J	3.6 J	1.4 J	1.2 J
Benzo(k)fluoranthene	3.7 J	15 J	1.6 J	12 J	3.8 J	11 J	8.7 J	12 J	2.6 J	1.9 J
Total benzofluoranthenes (calc'd)[a]	7.0 J	38 J	3.7 J	30 J	9.9 J	29 J	22 J	25 J	5.0 J	3.4 J
Chrysene	26	42	16 J	42	25 J	76	33	42	12 J	8.2 J
Dibenzo(a,h)anthracene	1.4 J	1.7 J	25 U	4.4 J	1.2 J	1.3 J	1.3 J	0.81 J	25 U	25 U
Dibenzofuran	1.7 J	2.5 J	0.82 J	1.9 J	1.5 J	6.0 J	3.7 J	32	0.73 J	25 U
Fluoranthene	26	73	23 J	52	41 J	430	58	270	19 J	10 J
Fluorene	3.1 J	4.3 J	1.5 J	3.1 J	2.5 J	14 J	12 J	57	1.1 J	0.83 J
Indeno(1,2,3-cd)pyrene	1.5 J	6.4 J	25 U	9.5 J	2.8 J	3.5 J	4.5 J	3.1 J	1.2 J	0.84 J
Naphthalene	5.0 J	5.5 J	5.1 J	5.3 J	7.3 J	6.4 J	6.4 J	6.5 J	6.5 J	5.4 J
Perylene	25 U	14 J	25 U	25 U	4.1 J	4.4 J	25 U	3.2 J	25 U	25 U
Phenanthrene	14 J	19 J	5.8 J	14 J	10 J	57	48	320	3.7 J	3.8 J
Pyrene	36	78	23 J	54	51	290	61	230	20 J	11 J
Total HPAH (calc'd)[a]	105 J	280 J	70 J	230 J	151 J	900 J	208 J	620 J	65 J	36 J
Total LPAH (calc'd)[a]	28 J	40 J	16 J	33 J	29 J	132 J	81 J	450 J	14.7 J	12.4 J

ANALYTE	B1a	B2a	B3a	B4a	B5a	B6a	B7a	B8a	B9a	B10a
Alkylated-PAHs										
C1-Dibenzothiophenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	25 UJ*	46 J*	25 UJ*	25 UJ*	25 UJ*
C1-Fluoranthene/Pyrene	25 UJ*	50 J*	25 UJ*	39 J*	46 UJ*	160 J*	43 J*	84 J*	25 UJ*	25 UJ*
C1-Fluorenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	34 J*	39 J*	25 UJ*	25 UJ*	25 UJ*
C1-Phenanthrenes/Anthracenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	140 J*	98 J*	120	25 UJ*	25 UJ*
C2-Dibenzothiophenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	25 UJ*	36 J*	25 UJ*	25 UJ*	25 UJ*
C2-Fluorenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	58 J*	84 J*	25 UJ*	25 UJ*	25 UJ*
C2-Naphthalenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	25 UJ*	68 J*	25 UJ*	25 UJ*	25 UJ*
C2-Phenanthrenes/Anthracenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	100 J*	94 J*	62 J*	25 UJ*	25 UJ*
C3-Fluorenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	44 J*	92 J*	25 UJ*	25 UJ*	25 UJ*
C3-Naphthalenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	25 UJ*	120 J*	25 UJ*	25 UJ*	25 UJ*
C3-Phenanthrenes/Anthracenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	55 J*	43 J*	60 J*	25 UJ*	25 UJ*	25 UJ*
C4-Naphthalenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	25 UJ*	110 J*	25 UJ*	25 UJ*	25 UJ*
C4-Phenanthrenes/Anthracenes	25 UJ*	25 UJ*	25 UJ*	25 UJ*	46 UJ*	25 UJ*	29 J*	25 UJ*	25 UJ*	25 UJ*
Phthalates										
Bis(2-ethylhexyl)phthalate	2,500 U	2,500 U	2,500 U	2,500 U	2,100 J	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U
Other SVOCs										
4-Methylphenol	400 U	400 U	230 J	86 J	730 U	400 U	400 U	400 U	44,000	400 U
4-Nitrophenol	2,000 U	2,000 U	2,000 U	2,000 U	2,300 J	2,000 U	2,000 U	2,000 U	2,000 U	2,000 U
Benzoic acid	4,000 U	4,200	1,700 J	2,700 J	8,200	9,700	1,500 J	1,300 J	1,900 J	1,000 J
Benzyl alcohol	200 U	200 U	57 J	200 U	1,100	200 U	200 U	200 U	90 J	200 U
Biphenyl	1.5 J	1.6 J	1.6 J	1.7 J	3.1 J	1.7 J	4.9 J	5.0 J	1.8 J	1.5 J
Dibenzothiophene	1.5 J	1.8 J	0.82 J	1.5 J	1.4 J	26	12 J	18 J	25 U	25 U
Pentachlorophenol	2,000 U	2,000 U	2,000 U	2,000 U	2,300 J	2,000 U	2,000 U	2,000 U	2,000 U	2,000 U
Phenol	580	150 J	150 J	490 U	910 U	120 J	120 J	490 U	200 J	490 U

[a] Totals were calculated following rules described in Appendix B

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; J* - Alkylated PAHs were analyzed by the method specified in the QAPP. The validation review did not result in qualification. The EPA QA office requested the J qualification based on the use of parent compound response factors to quantify the alkylated compounds.

Table 4-15. Concentrations of SVOCs (µg/kg ww) detected in at least one subtidal benthic invertebrate tissue sample

ANALYTE	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b
PAHs										
1-Methylnaphthalene	1.9 J	50 U	3.1 J	2.6 J	0.98 J	1.8 J	1.4 J	0.75 J	1.6 J	1.5 J
2-Methylnaphthalene	2.3 J	1.9 J	4.6 J	3.3 J	1.3 J	2.2 J	1.7 J	1.0 J	1.9 J	2.0 J
Acenaphthene	5.1 J	1.0 J	28	6.9 J	2.1 J	12 J	5.2 J	0.61 J	1.3 J	1.6 J
Acenaphthylene	3.5 J	2.6 J	12 J	5.0 J	3.0 J	3.8 J	1.8 J	0.57 J	0.67 J	0.55 J
Anthracene	18 J	10 J	110	53	9.8 J	25 J	16 J	1.6 J	1.7 J	1.1 J
Benzo(a)anthracene	35 J	31 J	270	190	42	89	39	7.4 J	6.1 J	1.7 J
Benzo(a)pyrene	21 J	16 J	190	130	20 J	56	22 J	3.5 J	3.2 J	25 U
Benzo(b)fluoranthene	34 J	32 J	290	160	46	85	38	6.0 J	6.4 J	1.9 J
Benzo(e)pyrene	33 J	28 J	250	130	41	72	37	7.3 J	7.0 J	4.2 J
Benzo(g,h,i)perylene	12 J	9.0 J	88	74	12 J	33	17 J	3.1 J	3.2 J	1.4 J
Benzo(k)fluoranthene	25 J	19 J	220	130	29	65	28	4.5 J	3.9 J	2.0 J
Total benzofluoranthenes (calc'd)[a]	59 J	51 J	510	290	75	150	66	10.5 J	10.3 J	3.9 J
Chrysene	61	46 J	780	260	72	120	58	12 J	11 J	8.3 J
Dibenzo(a,h)anthracene	2.2 J	1.6 J	25 J	20 J	1.8 J	5.9 J	3.0 J	25 U	0.61 J	25 U
Dibenzofuran	3.7 J	1.3 J	26	4.3 J	1.5 J	9.4 J	4.8 J	0.72 J	0.98 J	0.97 J
Fluoranthene	71	64	680	400	120	270	120	23 J	19 J	13 J
Fluorene	5.3 J	1.8 J	45	12 J	2.3 J	16 J	7.8 J	0.93 J	1.7 J	1.2 J
Indeno(1,2,3-cd)pyrene	10 J	6.9 J	87	83	9.4 J	33	13 J	2.2 J	2.3 J	0.80 J
Naphthalene	6.7 J	6.2 J	6.2 J	5.7 J	3.4 J	7.3 J	4.8 J	4.6 J	5.4 J	5.7 J
Perylene	11 J	13 J	69	45	11 J	35	39	16 J	4.5 J	25 U
Phenanthrene	27 J	13 J	230	150	12 J	48	32	5.0 J	6.3 J	5.0 J
Pyrene	120	94	570	500	270	260	170	20 J	20 J	13 J
Total HPAH (calc'd)[a]	390 J	320 J	3,200 J	1,950 J	620 J	1,020 J	510 J	82 J	76 J	42 J
Total LPAH (calc'd)[a]	66 J	35 J	430 J	230 J	33 J	112 J	68 J	13.3 J	17.1 J	15.2 J
Alkylated-PAHs										
C1-Chrysenes	49 UJ*	50 UJ*	240 J*	140 J*	36 J*	72 J*	38 J*	25 UJ*	25 UJ*	25 UJ*
C1-Fluoranthene/Pyrene	64 J*	61 J*	560 J*	250 J*	100 J*	140 J*	100 J*	25 UJ*	25 UJ*	25 UJ*
C1-Phenanthrenes/Anthracenes	49 UJ*	50 UJ*	140 J*	99 J*	25 UJ*	28 J*	26 J*	25 UJ*	25 UJ*	25 UJ*

ANALYTE	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b
C2-Chrysenes	49 UJ*	50 UJ*	140 J*	25 UJ*	25 UJ*	25 UJ*	25 UJ*	25 UJ*	25 UJ*	25 UJ*
C2-Fluorenes	49 UJ*	50 UJ*	72 J*	25 UJ*	25 UJ*	36 J*	25 UJ*	25 UJ*	25 UJ*	25 UJ*
C2-Phenanthrenes/Anthracenes	49 UJ*	50 UJ*	110 J*	74 J*	25 UJ*	28 J*	25 UJ*	25 UJ*	25 UJ*	25 UJ*
C3-Fluorenes	49 UJ*	50 UJ*	37 J*	47 J*	25 UJ*	25 UJ*	25 UJ*	25 UJ*	25 UJ*	25 UJ*
C3-Phenanthrenes/Anthracenes	49 UJ*	50 UJ*	71 J*	62 J*	25 UJ*	35 J*	44 J*	25 UJ*	25 UJ*	25 UJ*
C4-Phenanthrenes/Anthracenes	49 UJ*	50 UJ*	35 J*	43 J*	25 UJ*	25 UJ*	55 J*	25 UJ*	25 UJ*	25 UJ*
Phthalates										
Bis(2-ethylhexyl)phthalate	2,200 J	2,100 J	2,500 U	1,100 J	1,100 J	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U
Butyl benzyl phthalate	390 U	400 U	200 U	200 U	190 J	200 U	200 U	200 U	200 U	200 U
Other SVOCs										
2,4,5-Trichlorophenol	780 U	790 U	400 U	400 U	400 U	75 J	400 U	400 U	400 U	400 U
2,4,6-Trichlorophenol	780 U	790 U	400 U	400 U	400 U	47 J	400 U	400 U	400 U	400 U
2,4-Dimethylphenol	780 U	790 U	400 UJ	400 U	400 U	71 J	400 UJ	400 UJ	400 UJ	400 UJ
4-Chloroaniline	2,000 U	2,000 U	990 U	1,000 U	1,000 U	53 J	990 U	1,000 U	980 U	990 U
4-Methylphenol	780 U	790 U	150 J	400 U	400 U	200 J	77 J	400 U	400 U	400 U
4-Nitrophenol	3,900 U	4,000 U	2,000 U	2,000 U	2,000 U	280 J	2,000 U	2,000 U	2,000 U	2,000 U
Benzoic acid	3,800 J	4,500 J	4,000	3,700 J	14,000	1,400 J	2,700 J	1,900 J	1,900 J	990 J
Benzyl alcohol	69 J	400 U	100 J	83 J	61 J	410	200 U	200 U	200 U	200 U
Biphenyl	3.3 J	3.7 J	5.3 J	3.6 J	2.3 J	3.0 J	1.8 J	1.5 J	1.4 J	2.2 J
Dibenzothiophene	2.2 J	50 U	18 J	8.8 J	1.6 J	6.8 J	3.8 J	25 U	0.69 J	25 U
N-Nitroso-di-n-propylamine	390 U	400 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	3,700
N-Nitrosodiphenylamine	390 U	400 U	200 U	200 U	170 J	200 U	200 U	200 U	200 U	200 U
Pentachlorophenol	2,100 J	4,000 U	2,000 U	1,100 J	1,100 J	4,700	2,000 U	2,000 U	2,000 U	2,000 U
Phenol	980 U	990 U	300 J	500 U	91 J	160 J	500 U	99 UJ	490 U	500 U

[a] Totals were calculated following rules described in Appendix B.

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown; J* - Alkylated PAHs were analyzed by the method specified in the QAPP. The validation review did not result in qualification. The EPA QA office requested the J qualification based on the use of parent compound response factors to quantify the alkylated compounds.

SVOCs were detected in all intertidal and subtidal benthic invertebrate tissue samples and are described in more detail, as follows:

- A total of 30 SVOCs and 13 alkylated PAHs were detected in at least one intertidal tissue sample, and 37 SVOCs and 9 alkylated PAHs were detected in at least one subtidal tissue sample. The highest numbers of detects of individual compounds (excluding alkylated PAHs) occurred at intertidal location B7a (28) and subtidal location B6b (33).
- Total LPAH concentrations ranged from 12.4 to 450 µg/kg ww in the intertidal tissue samples and from 13.3 to 430 µg/kg ww in the subtidal tissue samples.
- Total HPAH concentrations ranged from 36 to 900 µg/kg ww in the intertidal tissue samples and from 42 to 3,200 µg/kg ww in the subtidal tissue samples.
- Two phthalates were detected in intertidal and subtidal tissue samples. Bis(2-ethylhexyl)phthalate was detected at locations B5a, B1b, B2b, B4b, and B5b at concentrations ranging from 1,100 to 2,200 µg/kg ww. Butyl benzyl phthalate was detected at location B5b at a concentration of 190 µg/kg ww.
- Eight and 14 other SVOCs were detected in at least one intertidal and subtidal tissue sample, respectively. The highest detected concentration was 14,000 µg/kg ww for benzoic acid at location B5b.

4.1.3.2 Sediment samples co-located with benthic invertebrate tissue samples

Table 4-16 presents a summary of the SVOCs analyzed in sediment samples co-located with benthic invertebrate tissue samples, including the number of detections, the range of detected SVOC concentrations (in µg/kg dw), and the range of reporting limits. Results for all SVOCs detected in at least one intertidal or subtidal co-located sediment sample are presented in Tables 4-17 and 4-18, respectively, and compared to SQS and CSL (in µg/kg dw or mg/kg OC). Concentrations in bold text are greater than the SQS. Concentrations in bold underlined text are greater than the both the SQS and the CSL. Reporting limits that exceed the applicable SQS or CSL are discussed in Section 4.1.7. The results are presented in full in Appendix A, Tables A-5 and A-6.

Table 4-16. Summary of SVOC concentrations in sediment samples co-located with benthic invertebrate tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
PAHs					
1-Methylnaphthalene	20/20	1.9 J	32	na	na
2-Chloronaphthalene	0/20	nd	nd	8.6	50
2-Methylnaphthalene	20/20	2.3 J	53	na	na
Acenaphthene	20/20	1.0 J	36	na	na
Acenaphthylene	20/20	1.5 J	180	na	na

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
Anthracene	20/20	4.2 J	1,100	na	na
Benzo(a)anthracene	20/20	12	2,800	na	na
Benzo(a)pyrene	20/20	16	1,400	na	na
Benzo(b)fluoranthene	20/20	21	1,900	na	na
Benzo(e)pyrene	20/20	16	1,300	na	na
Benzo(g,h,i)perylene	20/20	13	870	na	na
Benzo(k)fluoranthene	20/20	18	1,200	na	na
Total benzofluoranthenes (calc'd)[a]	20/20	39	3,000	na	na
Chrysene	20/20	23	5,400	na	na
Dibenzo(a,h)anthracene	20/20	2.4 J	240	na	na
Dibenzofuran	20/20	1.5 J	39	na	na
Fluoranthene	20/20	35	9,300	na	na
Fluorene	20/20	1.4 J	150	na	na
Indeno(1,2,3-cd)pyrene	20/20	13	890	na	na
Naphthalene	18/20	3.6 J	82	2.5	2.8
Perylene	20/20	9.0	350	na	na
Phenanthrene	20/20	15	2,400	na	na
Pyrene	20/20	32	7,100	na	na
Total HPAH (calc'd)[a]	20/20	191 J	26,000	na	na
Total LPAH (calc'd)[a]	20/20	23 J	3,100	na	na
Alkylated PAHs					
C1-Chrysenes	20/20	12 J*	980 J*	na	na
C1-Dibenzothiophenes	14/20	4.6 J	59 J*	5.0	5.5
C1-Fluoranthene/pyrene	19/20	18 J*	4,900 J*	4.9	4.9
C1-Fluorenes	10/20	4.5 J	150 J*	5.0	7.8
C1-Phenanthrenes/anthracenes	20/20	8.0 J*	1,700 J*	na	na
C2-Chrysenes	20/20	8.1 J*	660 J*	na	na
C2-Dibenzothiophenes	15/20	4.3 J	190 J*	5.0	5.4
C2-Fluorenes	16/20	3.4 J	250 J*	5.0	5.4
C2-Naphthalenes	20/20	6.2 J*	100 J*	na	na
C2-Phenanthrenes/anthracenes	20/20	8.5 J*	840 J*	na	na
C3-Chrysenes	20/20	7.3 J*	370 J*	na	na
C3-Dibenzothiophenes	16/20	7.6 J*	150 J*	4.9	5.0
C3-Fluorenes	18/20	3.9 J	220 J*	5.0	5.0
C3-Naphthalenes	20/20	4.4 J	310 J*	na	na
C3-Phenanthrenes/anthracenes	20/20	6.8 J*	420 J*	na	na
C4-Chrysenes	17/20	7.7 J*	130 J*	4.9	5.0
C4-Naphthalenes	20/20	6.0 J*	250 J*	na	na
C4-Phenanthrenes/anthracenes	20/20	5.6 J*	180 J*	na	na

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
Phthalates					
Bis(2-ethylhexyl)phthalate	18/20	28 J	260 J	15	39
Butyl benzyl phthalate	16/20	4.4 J	51	10	20
Diethyl phthalate	0/20	nd	nd	8.6	50
Dimethyl phthalate	7/20	3.4 J	19	10	50
Di-n-butyl phthalate	15/20	4.8 J	280	10	50
Di-n-octyl phthalate	0/20	nd	nd	11	100
Other SVOCs					
1,2-Dichlorobenzene	0/20	nd	nd	8.6	50
1,3-Dichlorobenzene	0/20	nd	nd	8.6	50
1,4-Dichlorobenzene	0/20	nd	nd	8.6	50
1,2,4-Trichlorobenzene	0/20	nd	nd	8.6	50
2,4,5-Trichlorophenol	0/20	nd	nd	8.6	50
2,4,6-Trichlorophenol	0/20	nd	nd	8.6	50
2,4-Dichlorophenol	0/20	nd	nd	8.6	50
2,4-Dimethylphenol	0/20	nd	nd	43	250
2,4-Dinitrophenol	0/20	nd	nd	180	1,000
2,4-Dinitrotoluene	0/20	nd	nd	8.6	50
2,6-Dinitrotoluene	0/20	nd	nd	8.6	50
2-Chlorophenol	0/20	nd	nd	8.6	50
2-Methylphenol	0/20	nd	nd	8.6	50
2-Nitroaniline	0/20	nd	nd	18	100
2-Nitrophenol	0/20	nd	nd	8.6	50
3,3'-Dichlorobenzidine	0/20	nd	nd	86	500
3-Nitroaniline	0/20	nd	nd	18	100
4,6-Dinitro-o-cresol	0/20	nd	nd	86	500
4-Bromophenyl phenyl ether	0/20	nd	nd	8.6	50
4-Chloro-3-methylphenol	0/20	nd	nd	8.6	50
4-Chloroaniline	0/20	nd	nd	8.6	50
4-Chlorophenyl phenyl ether	0/20	nd	nd	8.6	50
4-Methylphenol	5/20	4.8 J	22	8.6	50
4-Nitroaniline	0/20	nd	nd	18	100
4-Nitrophenol	0/20	nd	nd	86	500
Aniline	1/20	13 J	13 J	18	100
Benzidine	0/1	nd	nd	310	310
Benzoic acid	1/20	250	250	180	1,000
Benzyl alcohol	3/20	8.2 J	70 J	10	50
Biphenyl	20/20	0.86 J	33	na	na
bis(2-chloroethoxy)methane	0/20	nd	nd	8.6	50
bis(2-chloroethyl)ether	0/20	nd	nd	8.6	50

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
bis(2-chloroisopropyl)ether	0/20	nd	nd	8.6	50
Carbazole	19/20	3.2 J	180 J	20	20
Dibenzothiophene	20/20	0.81 J	150	na	na
Hexachlorobenzene	5/21	0.60 J	63	1.0	1.3
Hexachlorobutadiene	0/20	nd	nd	8.6	50
Hexachlorocyclopentadiene	0/20	nd	nd	43	250
Hexachloroethane	0/20	nd	nd	8.6	50
Isophorone	0/20	nd	nd	8.6	50
Nitrobenzene	0/20	nd	nd	8.6	50
N-Nitrosodimethylamine	0/20	nd	nd	43	250
N-Nitroso-di-n-propylamine	0/20	nd	nd	8.6	50
N-Nitrosodiphenylamine	0/20	nd	nd	8.6	50
Pentachlorophenol	3/20	14 J	92 J	50	250
Phenol	10/20	19 J	2,800	7.3	1,100

[a] Totals were calculated following rules described in Appendix B

Data qualifiers: J - estimated concentration; J* - Alkylated PAHs were analyzed by the method specified in the QAPP. The validation review did not result in qualification. The EPA QA office requested the J qualification based on the use of parent compound response factors to quantify the alkylated compounds.

na – not applicable

nd – not detected

Table 4-17. Concentrations of SVOCs detected in at least one intertidal sediment sample co-located with benthic invertebrate tissue samples compared to SQS and CSL

ANALYTE	UNIT	B1a	B2a	B3a	B4a	B5a-2	B6a	B7a	B8a	B9a	B10a	SQS	CSL
PAHs													
1-Methylnaphthalene	µg/kg dw	3.6 J	6.2	2.3 J	32	10	11	3.4 J	2.5 J	3.7 J	2.8 J	na	na
2-Methylnaphthalene	mg/kg-OC	0.24 J	0.38	0.20 J	2.7	1.0	1.7	0.28 J	0.10 J	0.20 J	0.18 J	38	64
Acenaphthene	mg/kg-OC	0.65	0.66	0.11 J	1.8	0.29	1.1	0.16 J	0.15	0.37	0.064 J	16	57
Acenaphthylene	mg/kg-OC	0.71	1.2	0.31 J	9.2	0.33	1.1	0.35 J	0.30	0.13 J	0.40	66	66
Anthracene	mg/kg-OC	1.6	3.8	0.68	17	1.1	2.5	0.98 J	0.85	1.3	0.81	220	1,200
Benzo(a)anthracene	mg/kg-OC	2.7	7.1	1.3	51	2.9	4.3	2.1	1.9	3.6	2.8	110	270
Benzo(a)pyrene	mg/kg-OC	3.1	11	1.3	56	2.6	3.9	2.5	2.0	3.7	4.3	99	210
Benzo(b)fluoranthene	µg/kg dw	46	280	21	1,900	54 J	53	52	110	74	77	na	na
Benzo(e)pyrene	µg/kg dw	43	210	16	1,300	44	46	43	87	65	73	na	na
Benzo(g,h,i)perylene	mg/kg-OC	2.4	7.1	0.96	**44**	2.9	3.8	2.1	1.8	2.9	4.4	31	78
Benzo(k)fluoranthene	µg/kg dw	50	210	18	1,100	46	41	47	75	84	78	na	na
Total benzofluoranthenes (calc'd)[a]	mg/kg-OC	5.6	25	2.9	150	7.1 J	11	6.0	5.7	7.4	9.0	230	450
Chrysene	mg/kg-OC	3.6	14	3.5	**130**	5.8	9.3	4.0	5.1	4.7	4.0	100	460
Dibenzo(a,h)anthracene	mg/kg-OC	0.39	1.7	0.18 J	6.6	0.61	0.70	0.38	0.36	0.61	0.98	12	33
Dibenzofuran	mg/kg-OC	0.38	0.42	0.18 J	2.0	0.41	0.89	0.21 J	0.13 J	0.21 J	0.13 J	15	58
Fluoranthene	mg/kg-OC	7.1	19	4.0	**470**	11	16	6.7	3.6	9.3	5.5	160	1,200
Fluorene	mg/kg-OC	0.42	0.71	0.20 J	4.9	0.46	0.87	0.29 J	0.21	0.39	0.12 J	23	79
Indeno(1,2,3-cd)pyrene	mg/kg-OC	2.2	7.6	0.96	**45**	2.6 J	3.3	2.1	1.7	2.9	4.3	34	88
Naphthalene	mg/kg-OC	0.58	0.66	0.27 J	4.2	0.71	1.6	0.34	0.13 J	0.17 J	0.16 UJ	99	170
Perylene	µg/kg dw	16	65	9.0	230	45	39	21 J	31	43	52	na	na
Phenanthrene	mg/kg-OC	2.8	7.1	2.1	**120**	2.2	4.3	2.5 J	1.6	4.4	1.6	100	480
Pyrene	mg/kg-OC	8.2	16	3.5	360	9.3	13	5.5	3.6	8.4	4.6	1,000	1,400
Total HPAH (calc'd)[a]	mg/kg-OC	35	110	18 J	**1,300**	45 J	65	31	26	43	40	960	5,300
Total LPAH (calc'd)[a]	mg/kg-OC	6.8	14	3.7 J	160	5.1	11	4.6 J	3.2 J	6.7 J	3.0 J	370	780
Alkylated-PAHs													
C1-Chrysenes	µg/kg dw	41 J*	150 J*	17 J*	980 J*	42 J*	58 J*	28 J*	74 J*	52 J*	55 J*	na	na
C1-Dibenzothiophenes	µg/kg dw	7.3 J	8.1 J*	5.0 UJ*	59 J*	32 J*	16 J*	8.7 J*	5.0 UJ*	11 J*	6.9 J*	na	na
C1-Fluoranthene/Pyrene	µg/kg dw	86 J*	200 J*	28 J*	2,600 J*	84 J*	98 J*	4.9 UJ*	130 J*	100 J*	58 J*	na	na
C1-Fluorenes	µg/kg dw	4.5 J	6.3 J*	5.0 UJ*	150 J*	7.8 UJ*	5.3 J*	5.3 J*	5.0 UJ*	5.0 UJ*	5.0 UJ*	na	na
C1-Phenanthrenes/anthracenes	µg/kg dw	39 J	77 J*	15 J*	1,700 J*	34 J*	34 J*	25 J*	37 J*	42 J*	19 J*	na	na
C2-Chrysenes	µg/kg dw	27 J*	66 J*	8.7 J*	370 J*	36 J*	82 J*	17 J*	67 J*	30 J*	57 J*	na	na
C2-Dibenzothiophenes	µg/kg dw	4.4 J	12 J*	5.0 UJ*	190 J*	18 J*	14 J*	7.2 J*	8.7 J*	5.3 J*	4.3 J	na	na

ANALYTE	UNIT	B1a	B2a	B3a	B4a	B5a-2	B6a	B7a	B8a	B9a	B10a	SQS	CSL
C2-Fluorenes	µg/kg dw	6.2 J	11 J*	5.0 UJ*	250 J*	17 J*	11 J*	8.5 J*	6.1 J*	5.1 J*	5.0 UJ*	na	na
C2-Naphthalenes	µg/kg dw	11 J*	14 J*	6.7 J*	100 J*	30 J*	22 J*	19 J*	7.8 J*	11 J*	10 J*	na	na
C2-Phenanthrenes/anthracenes	µg/kg dw	33 J	47 J*	11 J*	840 J*	40 J*	42 J*	22 J*	32 J*	27 J*	21 J*	na	na
C3-Chrysenes	µg/kg dw	19 J*	43 J*	7.3 J*	210 J*	43 J*	83 J*	12 J*	72 J*	20 J*	55 J*	na	na
C3-Dibenzothiophenes	µg/kg dw	13 J*	20 J*	5.0 UJ*	130 J*	32 J*	26 J*	4.9 UJ*	20 J*	13 J*	14 J*	na	na
C3-Fluorenes	µg/kg dw	9.3 J*	15 J*	5.2 J*	220 J*	36 J*	17 J*	12 J*	13 J*	8.9 J*	5.0 UJ*	na	na
C3-Naphthalenes	µg/kg dw	19 J*	26 J*	4.4 J	310 J*	46 J*	34 J*	34 J*	17 J*	24 J*	25 J*	na	na
C3-Phenanthrenes/anthracenes	µg/kg dw	27 J	32 J*	6.8 J*	420 J*	62 J*	55 J*	15 J*	47 J*	21 J*	24 J*	na	na
C4-Chrysenes	µg/kg dw	12 J*	20 J*	5.0 UJ*	78 J*	40 J*	51 J*	4.9 UJ*	56 J*	12 J*	43 J*	na	na
C4-Naphthalenes	µg/kg dw	13 J*	14 J*	6.0 J*	250 J*	68 J*	24 J*	26 J*	9.3 J*	16 J*	14 J*	na	na
C4-Phenanthrenes/anthracenes	µg/kg dw	15 J*	29 J*	5.6 J*	150 J*	90 J*	28 J*	14 J*	32 J*	23 J*	15 J*	na	na
Phthalates													
Bis(2-ethylhexyl)phthalate	mg/kg-OC	0.88 UJ	2.7 J	4.9 J	7.1 J	3.7 J	6.9 J	3.8 J	5.7 J	9.8 J	2.3 U	47	78
Butyl benzyl phthalate	mg/kg-OC	0.59 U	0.81	1.5 U	1.1	0.53 J	1.8 J	0.67 J	1.5	0.79 J	0.42 J	4.9	64
Dimethyl phthalate	mg/kg-OC	0.59 U	0.51 U	1.5 U	1.0 U	0.24 J	2.2 U	0.43 J	1.5 U	0.93 U	1.2 U	53	53
Di-n-butyl phthalate	mg/kg-OC	0.34 J	0.51 U	0.63 J	0.82 J	0.51 J	0.87 J	1.2 U	8.5	0.61 J	0.64 J	220	1,700
Other SVOCs													
4-Methylphenol	µg/kg dw	10 U	10 U	22	20 U	8.6 U	20 U	20 U	50 U	20 U	20 U	670	670
Aniline	µg/kg dw	20 U	20 U	40 U	40 U	18 UJ	40 U	40 U	99 U	40 U	40 U	na	na
Benzyl alcohol	µg/kg dw	10 U	10 U	20 U	20 U	8.2 J	20 U	20 U	50 U	20 U	20 U	57	73
Biphenyl	µg/kg dw	2.0 J	2.9 J	1.4 J	33	4.1	4.0 J	2.1 J	1.5 J	1.5 J	1.4 J	na	na
Carbazole	µg/kg dw	4.7 J	18	20 U	25	7.6 J	6.3 J	6.2 J	26 J	19 J	6.9 J	na	na
Dibenzothiophene	µg/kg dw	3.0 J	6.8	1.1 J	150	5.0	4.1 J	3.0 J	3.1 J	4.6 J	1.5 J	na	na
Hexachlorobenzene	mg/kg-OC	0.059 U	0.051 U	0.074 U	0.27 JN	0.043 J[b]	0.11 U	**3.8**	0.030 U	0.065 J	0.075 U	0.38	2.3
Pentachlorophenol	µg/kg dw	50 U	50 U	100 U	80 J	14 J	100 U	100 U	250 U	100 U	100 U	360	690
Phenol	µg/kg dw	78	34	220	23 U	24 J	31 U	13 U	**2,800**	27 J	**1,100 U**	420	1,200

[a] Totals were calculated following rules described in Appendix B.

[b] The sample from B5a-1 had a hexachlorobenzene concentration of 0.34U

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown; JN - analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification; reported concentration is an estimate; J* - Alkylated PAHs were analyzed by the method specified in the QAPP. The validation review did not result in qualification. The EPA QA office requested the J qualification based on the use of parent compound response factors to quantify the alkylated compounds.

Bold indicates concentration or reporting limit above the SQS; **Bold underlined** indicates concentration or reporting limit above the CSL

Dry weight concentrations for OC-normalized results are presented in Appendix A

na – neither SQS/SL nor CSL/ML is available

Table 4-18. Concentrations of SVOCs detected in at least one subtidal sediment sample co-located with benthic invertebrate tissue samples compared to SQS and CSL

ANALYTE	UNITS	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b	SQS	CSL
PAHs													
1-Methylnaphthalene	µg/kg dw	3.1 J	6.2	14	11	7.0	5.7	5.9	4.9 J	5.8	1.9 J	na	na
2-Methylnaphthalene	mg/kg-OC	0.62 J	0.91	1.9	0.50	0.67	0.27	0.59	0.25	0.40	0.21 J	38	64
Acenaphthene	mg/kg-OC	1.3 J	0.82	1.9	0.47	0.79	0.41	0.85	0.10 J	0.22 J	0.092 J	16	57
Acenaphthylene	mg/kg-OC	0.92 J	1.2	4.4	1.0	2.2	0.64	0.73	0.17 J	0.36	0.14 J	66	66
Anthracene	mg/kg-OC	3.6 J	4.5	60	2.9	7.2	2.5	3.1	0.51	0.86	0.39 J	220	1,200
Benzo(a)anthracene	mg/kg-OC	8.0 J	9.6	**150**	7.5	23	5.7	7.4	1.8	2.8	1.1	110	270
Benzo(a)pyrene	mg/kg-OC	7.8 J	10	77	7.2	16	5.4	7.5	2.5	3.6	1.5	99	210
Benzo(b)fluoranthene	µg/kg dw	43 J	120	1,700	310	340	190	110	71	75	21	na	na
Benzo(e)pyrene	µg/kg dw	39 J	99	1,300	220	230	150	96	61	62	17	na	na
Benzo(g,h,i)perylene	mg/kg-OC	6.4 J	7.7	**33**	5.0	8.6	3.4	5.3	2.4	3.2	1.6	31	78
Benzo(k)fluoranthene	µg/kg dw	36 J	91	1,200	200	230	180	120	67	72	18	na	na
Total benzofluoranthenes (calc'd)[a]	mg/kg-OC	16 J	23	160	18	41	13	18	5.8	8.4	3.6	230	450
Chrysene	mg/kg-OC	13 J	15	**300**	15	37	8.8	12	3.3	5.5	2.1	100	460
Dibenzo(a,h)anthracene	mg/kg-OC	0.90 J	1.3	**13**	0.93	1.7	0.81	1.0	0.39	0.63	0.22 J	12	33
Dibenzofuran	mg/kg-OC	1.4 J	0.87	2.0	0.47	0.79	0.44	1.0	0.17 J	0.27 J	0.14 J	15	58
Fluoranthene	mg/kg-OC	30 J	22	**200**	22	64	14	19	5.1	7.5	3.2	160	1,200
Fluorene	mg/kg-OC	1.4 J	1.3	8.2	0.68	1.3	0.61	1.0	0.15 J	0.30	0.13 J	23	79
Indeno(1,2,3-cd)pyrene	mg/kg-OC	5.6 J	7.4	**36**	5.0	9.4	3.7	5.2	2.3	3.3	1.4	34	88
Naphthalene	mg/kg-OC	1.5	1.3	2.0	0.82	0.72	0.37	0.66	0.20 J	0.43	0.23 UJ	99	170
Perylene	µg/kg dw	16 J	38	350	78	74	66	51	50	48	15	na	na
Phenanthrene	mg/kg-OC	7.8 J	8.8	42	5.7	7.9	4.4	6.5	1.8	2.7	1.4	100	480
Pyrene	mg/kg-OC	30 J	22	130	18	47	10	18	4.2	7.5	2.9	1,000	1,400
Total HPAH (calc'd)[a]	mg/kg-OC	120 J	120	**1,100**	100	250	64	93	28	43	18 J	960	5,300
Total LPAH (calc'd)[a]	mg/kg-OC	17 J	18	120	12	20	8.8	13	2.9 J	4.9 J	2.1 J	370	780
Alkylated PAHs													
C1-Chrysenes	µg/kg dw	27 J*	73 J*	2,100 J*	200 J*	200 J*	130 J*	83 J*	36 J*	39 J*	12 J*	na	na
C1-Dibenzothiophenes	µg/kg dw	5.0 UJ*	5.0 UJ*	45 J*	5.5 UJ*	5.0 UJ*	12 J*	16 J*	9.3 J*	14 J*	4.6 J	na	na
C1-Fluoranthene/pyrene	µg/kg dw	62 J*	140 J*	4,900 J*	340 J*	470 J*	240 J*	150 J*	70 J*	72 J*	18 J*	na	na
C1-Fluorenes	µg/kg dw	5.0 UJ*	5.0 UJ*	55 J*	7.4 J*	5.8 J*	8.7 J*	5.4 J*	5.4 UJ*	5.0 UJ*	5.0 UJ*	na	na
C1-Phenanthrenes/anthracenes	µg/kg dw	21 J*	50 J*	1,000 J*	120 J*	94 J*	90 J*	50 J*	21 J*	25 J*	8.0 J*	na	na
C2-Chrysenes	µg/kg dw	15 J*	51 J*	660 J*	100 J*	100 J*	66 J*	51 J*	23 J*	23 J*	8.1 J*	na	na
C2-Dibenzothiophenes	µg/kg dw	5.0 UJ*	5.0 UJ*	130 J*	30 J*	20 J*	14 J*	10 J*	5.4 UJ*	7.9 J*	5.0 UJ*	na	na
C2-Fluorenes	µg/kg dw	3.4 J	11 J*	140 J*	16 J*	17 J*	17 J*	9.4 J*	5.4 UJ*	6.9 J*	5.0 UJ*	na	na

ANALYTE	UNITS	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b	SQS	CSL
C2-Naphthalenes	µg/kg dw	6.9 J*	15 J*	52 J*	21 J*	21 J*	18 J*	18 J*	15 J*	20 J*	6.2 J*	na	na
C2-Phenanthrenes/anthracenes	µg/kg dw	15 J*	36 J*	560 J*	77 J*	71 J*	61 J*	43 J*	23 J*	24 J*	8.5 J*	na	na
C3-Chrysenes	µg/kg dw	13 J*	38 J*	370 J*	72 J*	70 J*	44 J*	35 J*	21 J*	21 J*	9.7 J*	na	na
C3-Dibenzothiophenes	µg/kg dw	5.0 UJ*	5.0 UJ*	150 J*	51 J*	27 J*	22 J*	21 J*	14 J*	17 J*	7.6 J*	na	na
C3-Fluorenes	µg/kg dw	3.9 J	19 J*	170 J*	29 J*	30 J*	26 J*	15 J*	9.3 J*	12 J*	5.0 UJ*	na	na
C3-Naphthalenes	µg/kg dw	16 J*	24 J*	61 J*	30 J*	25 J*	34 J*	20 J*	35 J*	46 J*	17 J*	na	na
C3-Phenanthrenes/anthracenes	µg/kg dw	10 J*	31 J*	400 J*	66 J*	60 J*	48 J*	36 J*	19 J*	23 J*	7.6 J*	na	na
C4-Chrysenes	µg/kg dw	7.7 J*	18 J*	130 J*	27 J*	31 J*	21 J*	17 J*	12 J*	7.8 J*	5.0 UJ*	na	na
C4-Naphthalenes	µg/kg dw	8.3 J*	18 J*	57 J*	24 J*	18 J*	27 J*	29 J*	20 J*	36 J*	9.2 J*	na	na
C4-Phenanthrenes/anthracenes	µg/kg dw	12 J*	30 J*	180 J*	53 J*	47 J*	39 J*	37 J*	26 J*	27 J*	12 J*	na	na
Phthalates													
Bis(2-ethylhexyl)phthalate	mg/kg-OC	5.6 J	18 J	14 J	5.0 J	7.9 J	5.4 J	5.0 J	2.5 J	4.0 J	3.2 J	47	78
Butyl benzyl phthalate	mg/kg-OC	2.0 U	2.3 J	1.5 J	0.39 UJ	0.61 J	0.78	0.72 J	0.39 J	1.0	0.40 J	4.9	64
Dimethyl phthalate	mg/kg-OC	2.0 U	0.41 J	2.7 U	0.39 UJ	0.26 J	0.22 J	1.5 U	0.20 J	1.1	0.92 UJ	53	53
Di-n-butyl phthalate	mg/kg-OC	0.96 J	1.1 J	2.7 U	0.33 J	0.62 J	1.3	1.5 U	0.29 J	0.55 J	0.92 UJ	220	1,700
Other SVOCs													
4-Methylphenol	µg/kg dw	4.8 J	11 J	50 U	21	10 U	6.2 J	20 U	11 U	10 U	10 U	670	670
Aniline	µg/kg dw	20 UJ	20 U	100 U	22 UJ	20 UJ	13 J	40 U	22 UJ	20 U	20 UJ	na	na
Benzoic acid	µg/kg dw	200 U	200 U	1,000 U	250	200 U	210 U	400 U	220 U	200 U	200 U	650	650
Benzyl alcohol	µg/kg dw	10 U	10 U	50 U	**70 J**	10 U	13	20 U	11 UJ	10 U	10 UJ	57	73
Biphenyl	µg/kg dw	2.2 J	3.1 J	8.9	4.8 J	4.3 J	3.8 J	3.4 J	2.4 J	3.0 J	0.86 J	na	na
Carbazole	µg/kg dw	12	24	54	180 J	20	41	29	8.1 J	7.7 J	3.2 J	na	na
Dibenzothiophene	µg/kg dw	2.3 J	4.0 J	35	9.0	6.8	7.6	5.7	2.5 J	3.1 J	0.81 J	na	na
Hexachlorobenzene	mg/kg-OC	0.20 U	0.11 U	0.055 U	0.036 U	0.072 U	0.064	0.077 U	0.042 U	0.057 U	0.092 U	0.38	2.3
Pentachlorophenol	µg/kg dw	50 U	50 U	92 J	55 U	50 U	53 U	100 U	54 U	50 U	50 U	360	690
Phenol	µg/kg dw	19 J	48	52 U	33 U	11 UJ	35	10 U	7.3 UJ	92	10 UJ	420	1,200

[a] Totals were calculated following rules described in Appendix B

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown; J* - Alkylated PAHs were analyzed by the method specified in the QAPP. The validation review did not result in qualification. The EPA QA office requested the J qualification based on the use of parent compound response factors to quantify the alkylated compounds.

Bold indicates concentration or reporting limit above the SQS; **Bold underlined** indicates concentration or reporting limit above the CSL

na – neither SQS/SL nor CSL/ML is available

SVOCs were detected in all intertidal and subtidal sediment samples co-located with benthic invertebrate tissue samples and are described in more detail, as follows:

- A total of 34 SVOCs and 18 alkylated PAHs were detected in at least one intertidal sediment sample, and 35 SVOCs and 18 alkylated PAHs were detected in at least one subtidal sediment sample. The highest numbers of detected SVOCs (excluding alkylated PAHs) occurred at intertidal location B5a-2 (31) and subtidal location B6b (34).
- Total LPAH concentrations ranged from 3.0 to 160 mg/kg OC in the intertidal sediment samples and from 2.1 to 120 mg/kg OC in the subtidal sediment samples.
- Total HPAH concentrations ranged from 18 to 1,300 mg/kg OC in the intertidal sediment samples and from 18 to 1,100 mg/kg OC in the subtidal sediment samples.
- Benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and total HPAH in the intertidal sediment sample from location B4a exceeded their respective SQS.
- Benzo(a)anthracene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and total HPAH in the subtidal sediment sample from location B3b exceeded their respective SQS.
- Four phthalates (bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, dimethyl phthalates, and di-n-butyl phthalate) were detected in the intertidal and subtidal sediment samples. None of the detected concentrations exceeded their respective SQS.
- The concentrations of hexachlorobenzene at intertidal location B7a and phenol at location B8a exceeded their respective CSLs.
- The benzyl alcohol concentration at location B4b exceeded the SQS.

4.1.4 PCBs and organochlorine pesticides

The results from the PCBs as Aroclors and organochlorine pesticide analyses of benthic invertebrate tissue and co-located sediment samples are presented in Sections 4.1.4.1 and 4.1.4.2.

4.1.4.1 Benthic invertebrate tissue

Table 4-19 presents a summary of the PCBs as Aroclors and organochlorine pesticides analyzed in benthic invertebrate tissue samples, including the number of detections, the range of detected concentrations, and the range of reporting limits. Results for all PCBs and organochlorine pesticides detected at least one intertidal or subtidal benthic invertebrate tissue sample are presented in Tables 4-20 and 4-21, respectively. The results are presented in full in Appendix A, Tables A-3 and A-4.

Table 4-19. Summary of PCBs as Aroclors and organochlorine pesticide concentrations detected in benthic invertebrate tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
Aroclor 1016	0/20	nd	nd	97	180
Aroclor 1221	0/20	nd	nd	200	360
Aroclor 1232	0/20	nd	nd	97	180
Aroclor 1242	0/20	nd	nd	97	180
Aroclor 1248	0/20	nd	nd	97	180
Aroclor 1254	18/20	60 J	730	99	100
Aroclor 1260	2/20	660	1,400	97	180
Total PCBs (calc'd)[a]	19/20	60 J	1,400	200	200
2,4'-DDD	6/20	4.1 JN	43 J	9.7	21
2,4'-DDE	3/20	3.0 JN	11 JN	9.7	45
2,4'-DDT	11/20	7.4 JN	83 J	9.7	34
4,4'-DDD	6/20	2.2 J	13 J	9.7	18
4,4'-DDE	14/20	1.4 JN	39	9.8	10
4,4'-DDT	16/20	4.4 JN	82	9.7	17
Total DDTs (calc'd)[a]	20/20	2.2 J	167 J	na	na
Aldrin	0/20	nd	nd	9.7	18
Dieldrin	1/20	2.8 J	2.8 J	9.7	18
alpha-BHC	1/20	21 JN	21 JN	9.7	18
alpha-Chlordane	1/20	12 JN	12 JN	9.7	18
alpha-Endosulfan	4/20	2.8 J	30	9.7	15
beta-BHC	4/20	7.9 JN	13 JN	9.7	18
beta-Endosulfan	4/20	6.8 JN	16 JN	9.9	18
delta-BHC	0/20	nd	nd	9.7	18
Endosulfan sulfate	0/20	nd	nd	9.7	190
Endrin	0/20	nd	nd	9.7	18
Endrin aldehyde	2/20	2.4 J	11	9.7	18
Endrin ketone	2/20	6.5 JN	8.4 J	9.7	18
gamma-BHC	0/20	nd	nd	9.7	18
gamma-Chlordane	10/20	1.4	22 JN	9.8	18
Heptachlor	1/20	8.6 J	8.6 J	9.7	18
Heptachlor epoxide	3/20	2.8 J	6.6 J	9.7	18
Methoxychlor	3/20	5.6 JN	42	9.7	15
Mirex	0/20	nd	nd	9.7	18
Toxaphene	0/20	nd	nd	490	2,100

[a] Totals were calculated following rules described in Appendix B

Data qualifiers: J - estimated concentration; JN - analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification; reported concentration is an estimate

na – not applicable; nd – not detected

Table 4-20. Concentrations of PCBs as Aroclors and organochlorine pesticides (µg/kg ww) detected in at least one intertidal benthic invertebrate tissue sample

ANALYTE	B1a	B2a	B3a	B4a	B5a-2	B6a	B7a	B8a	B9a	B10a
Aroclor 1254	66 J	180	92 J	99 U	730	220	110 J	100 U	110	62 J
Aroclor 1260	100 U	100 U	100 U	99 U	660	98 U	140 U	1,400	99 U	100 U
Total PCBs (calc'd)[a]	66 J	180	92 J	200 U	1,390	220	110 J	1,400	110	62 J
2,4'-DDD	4.1 JN	11 U	6.9 J	16 U	15 U	9.8 U	14 U	43 J	21 U	10 U
2,4'-DDE	10 U	10 U	10 U	9.9 U	15 U	3.0 JN	14 U	45 U	9.9 U	5.8 J
2,4'-DDT	7.4 JN	10 U	17	9.9 U	70 J	10 U	18 J	34 U	16	10 U
4,4'-DDD	10 U	10 U	10 U	9.9 U	13 J	2.5 JN	14 U	10 U	9.9 U	2.5 J
4,4'-DDE	10 U	10 U	10 U	1.4 JN	39	9.8 U	2.9 J	10 U	9.9 U	3.5 J
4,4'-DDT	4.4 JN	10 JN	6.3 J	5.8 JN	45	12 JN	14 U	82	9.9 U	4.5 J
Total DDTs (calc'd)[a]	15.9 JN	10 JN	30 J	7.2 JN	167 J	18 JN	21 J	125 J	16	16.3 J
alpha-Endosulfan	10 U	3.9 JN	10 U	9.9 U	15 U	9.8 U	14 U	10 U	9.9 U	3.8 J
beta-BHC	10 U	12 U	13 J	7.9 JN	15 UJ	13 JN	14 U	10 U	10	10 U
beta-Endosulfan	10 U	8.0 JN	10 U	9.9 U	15 U	6.8 JN	14 U	10 U	9.9 U	10 U
Dieldrin	10 U	10 U	10 U	9.9 U	15 U	9.8 U	14 U	10 U	9.9 U	2.8 J
Endrin aldehyde	10 U	10 U	2.4 J	9.9 U	15 U	9.8 U	14 U	10 U	11	10 U
gamma-Chlordane	10 U	10 U	10 U	3.1 JN	16	9.8 U	3.9 J	12 U	9.9 U	10 U
Heptachlor	10 U	10 U	10 U	9.9 U	15 U	9.8 U	14 U	10 U	8.6 J	10 U
Heptachlor epoxide	10 U	10 U	10 U	9.9 U	15 U	9.8 U	6.6 J	10 U	9.9 U	10 U
Methoxychlor	10 U	5.6 JN	10 U	9.9 U	15 U	9.8 U	14 U	10 U	9.9 U	10 U

[a] Totals were calculated following rules described in Appendix B

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown; JN - analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification; reported concentration is an estimate

Table 4-21. Concentrations of PCBs as Aroclors and organochlorine pesticides (µg/kg ww) detected in at least one subtidal benthic invertebrate tissue sample

ANALYTE	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b
Aroclor 1254	100	240	310	160	210	220	180	60 J	99 J	74 J
Total PCBs (calc'd)[a]	100	240	310	160	210	220	180	60 J	99 J	74 J
2,4'-DDD	10 U	16 J	10 U	9.9 U	13 J	17 J	9.9 U	9.7 U	9.9 U	10 U
2,4'-DDE	10 U	10 U	11 JN	9.9 U	9.9 U	18 U	9.9 U	9.7 U	9.9 U	10 U
2,4'-DDT	10 U	38 J	28 U	18 J	83 J	44 J	12 U	9.7 U	9.9 JN	8.0 J
4,4'-DDD	10 U	3.9 J	10 U	2.4 J	2.2 J	18 U	9.9 U	9.7 U	9.9 U	10 U
4,4'-DDE	5.0 J	5.5 J	9.0 JN	4.4 J	4.8 J	3.9 J	3.7 JN	2.2 J	2.7 JN	2.1 J
4,4'-DDT	11	18	17 U	14	18	27 J	10 JN	9.7 U	6.8 JN	5.2 J
Total DDTs (calc'd)[a]	16 J	81 J	20 JN	39 J	121 J	92 J	14 JN	2.2 J	19.4 JN	15.3 J
alpha-BHC	10 U	10 U	21 JN	9.9 U	9.9 U	18 U	9.9 U	9.7 U	9.9 U	10 U
alpha-Chlordane	10 U	10 U	12 JN	9.9 U	9.9 U	18 U	9.9 U	9.7 U	9.9 U	10 U
alpha-Endosulfan	10 U	10 U	10 U	2.8 J	9.9 U	30	9.9 U	9.7 U	9.9 U	10 U
beta-Endosulfan	10 U	10 U	10 U	9.9 U	9.9 U	18 U	16 JN	13	9.9 U	10 U
Endrin ketone	10 U	10 U	6.5 JN	9.9 U	8.4 J	18 U	9.9 U	9.7 U	9.9 U	10 U
gamma-Chlordane	4.9 J	7.0 J	22 JN	3.4 J	9.9 U	18 U	4.3 JN	1.4	3.7 JN	10 U
Heptachlor epoxide	10 U	10 U	10 U	6.0 J	9.9 U	18 U	9.9 U	9.7 U	9.9 U	2.8 J
Methoxychlor	6.3 J	10 U	10 U	9.9 U	9.9 U	42	9.9 U	9.7 U	9.9 U	10 U

[a] Totals were calculated following rules described in Appendix B

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown; JN - analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification; reported concentration is an estimate

PCBs as Aroclors and organochlorine pesticides were detected in all intertidal and subtidal benthic invertebrate tissue samples and are described in more detail, as follows:

- Aroclor 1254 was detected at all intertidal and subtidal locations except B4a and B8a, with concentrations ranging from 60 µg/kg ww at location B8b to 730 µg/kg ww at location B5a. Aroclor 1260 was detected in tissue samples from intertidal locations B5a and B8a at concentrations of 660 µg/kg ww and 1,400 µg/kg ww, respectively. Total PCBs ranged from 60 µg/kg ww at subtidal location B8b to 1,400 µg/kg ww at intertidal location B8a.
- DDTs were detected at all intertidal and subtidal locations. Total DDT concentrations ranged from 2.2 µg/kg ww at location B8b to 167 µg/kg ww at location B5a.
- Nine and eight other pesticides were detected in at least one intertidal and subtidal benthic invertebrate tissue sample, respectively. Of these pesticides, methoxychlor was measured at the highest concentration (42 µg/kg ww at location B6b).

4.1.4.2 Sediment co-located with benthic invertebrate tissue samples

Table 4-22 presents a summary of the PCBs as Aroclors and organochlorine pesticides analyzed in co-located sediment samples, including the number of detections, the range of detected concentrations, and the range of reporting limits. Results for all PCBs and organochlorine pesticides detected in at least one intertidal or subtidal co-located sediment sample are presented in Tables 4-23 and 4-24, and compared to SQS/SL and CSL/ML. Concentrations in bold text are greater than the SQS (or SL). Concentrations in bold underlined text are above the CSL (or ML). Reporting limits that were above the applicable SQS/SL and CSL/ML are discussed in Section 4.1.7. Two sediment samples collected near and at location B5a were analyzed for PCBs and organochlorine pesticides (see Section 2.1.1 for collection information regarding these two sediment samples). Results for both of these locations are presented in this section. The results are presented in full in Appendix A, Tables A-5 and A-6. The frequency distribution for PCBs measured at intertidal and subtidal stations is presented in Figure 4-4. The sampling locations were selected to characterize the concentrations of PCBs in benthic invertebrate tissues throughout the LDW over a range of concentrations in sediment.

Table 4-22. Summary of PCBs as Aroclors and organochlorine pesticide concentrations in sediment samples co-located with benthic invertebrate tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
Aroclor 1016	0/21	nd	nd	5.2	100
Aroclor 1221	0/21	nd	nd	11	200
Aroclor 1232	0/21	nd	nd	5.2	100
Aroclor 1242	5/21	8.8 J	180	5.2	100
Aroclor 1248	4/21	50	600	5.2	140
Aroclor 1254	16/21	22	1,300 J	10	10
Aroclor 1260	18/21	9.8 J	4600	10	10
Total PCBs (calc'd)[a]	20/21	9.8 J	5,900 J	20	20
2,4'-DDD	3/21	1.6 J	9.3 J	1.0	19
2,4'-DDE	2/21	2.8 J	11	1.0	12
2,4'-DDT	19/21	0.44 JN	8.8 JN	5.0	5.2
4,4'-DDD	19/21	0.29 J	23 J	1.0	1.0
4,4'-DDE	12/21	0.28 J	31	1.0	6.5
4,4'-DDT	20/21	1.4 J	36 J	1.0	1.0
Total DDTs (calc'd)[a]	21/21	0.9 JN	380 J	na	na
Aldrin	1/21	1.6	1.6	1.0	1.0
Dieldrin	2/21	0.48 J	2.3	1.0	4.8
alpha-BHC	1/21	1.8 J	1.8 J	1.0	1.0
alpha-Chlordane	7/21	0.24 JN	1.6	1.0	1.5
alpha-Endosulfan	1/21	0.21 J	0.21 J	1.0	2.3
beta-BHC	0/21	nd	nd	1.0	1.2
beta-Endosulfan	2/21	0.54 J	10 J	1.0	6.3
delta-BHC	0/21	nd	nd	1.0	1.5
Endosulfan sulfate	1/21	25	25	1.0	1.0
Endrin	1/21	1.5 J	1.5 J	1.0	14
Endrin aldehyde	0/21	nd	nd	1.0	12
Endrin ketone	5/21	0.83 J	62 J	1.0	6.0
gamma-BHC	6/21	0.18 JN	1.3 J	1.0	2.8
gamma-Chlordane	7/21	0.97 J	16 J	1.0	11
Heptachlor	0/21	nd	nd	1.0	2.4
Heptachlor epoxide	2/21	0.47 J	4.9 J	1.0	6.2
Methoxychlor	2/21	0.84 JN	5.0 J	1.0	22
Mirex	2/21	0.29 J	0.37 J	1.0	13
Toxaphene	2/21	340 J	6,300 J	50	270

[a] Totals were calculated following rules described in Appendix B

Data qualifier: J - estimated concentration; JN - analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification; reported concentration is an estimate

na – not available/nd – not detected

Table 4-23. Concentrations of PCBs as Aroclors and organochlorine pesticides detected in at least one sediment sample co-located with intertidal benthic invertebrate tissue samples compared to SQS/SL and CSL/ML

ANALYTE	UNIT	B1a	B2a	B3a	B4a	B5a-1	B5a-2	B6a	B7a	B8a	B9a	B10a	SQS/SL	CSL/ML
Aroclor 1242	µg/kg dw	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5.2 U	100 U	180	10 U	na	na
Aroclor 1248	µg/kg dw	10 U	10 U	10 U	10 U	50	600	10 U	5.2 U	100 U	10 U	10 U	na	na
Aroclor 1254	µg/kg dw	10 U	80	22	170	10 U	630	150	26	1,300 J	85	10 U	na	na
Aroclor 1260	µg/kg dw	10 U	83	10 U	160	54 J	500	150	35	4,600	10 U	22	na	na
Total PCBs[a]	µg/kg dw	20 U	160	22	330	100 J	1,700	300	61	5,900 J	270	22	na	na
Total PCBs (calc'd)[a]	mg/kg-OC	1.2 U	8.3	1.6	**17**	**36 J**	**120**	**34**	3.7	**180 J**	**13**	1.3	12	65
2,4'-DDD	µg/kg dw	1.0 U	1.6 U	1.0 U	1.9 U	9.3 J	14 U	3.1 U	1.2 U	9.4 U	1.0 U	1.6 J	na	na
2,4'-DDE	µg/kg dw	1.0 U	1.5 U	1.0 U	1.0 U	1.0 U	2.8 J	1.0 U	11	5 U	1.0 U	1.0 U	na	na
2,4'-DDT	µg/kg dw	0.44 JN	5.4 JN	1.3	8.8 JN	7.9 J	5.5	7.6 JN	6.3 J	5 U	3.9 J	1.4 J	na	na
4,4'-DDD	µg/kg dw	0.46 JN	0.40 JN	0.31 J	1.0 U	23 J	22	4.7 JN	3.5 J	1.0 U	0.79 J	0.96 J	na	na
4,4'-DDE	µg/kg dw	1.0 U	1.0 U	0.45 J	3.5 JN	8.4 J	31	5.3 JN	2.3	6.5 U	1.0 U	0.75 J	na	na
4,4'-DDT	µg/kg dw	1.0 U	5.5 JN	1.6	9.3 JN	19 J	16	9.3 JN	12	36	5.4	3.5	na	na
Total DDTs (calc'd)[a,b]	µg/kg dw	0.90 JN	**11 JN**	3.7 J	**22 JN**	**68 J**	**77 J**	**27 JN**	**35 J**	**36 J**	**10 J**	**8.2 J**	6.9	69
Dieldrin[b]	µg/kg dw	1.0 U	1.0 U	1.0 U	1.0 U	0.48 J	1.0 U	1.0 U	1.0 U	4.8 U	1.0 U	2.3	10	na
alpha-BHC	µg/kg dw	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.8 J	1.0 U	1.0 U	na	na
alpha-Chlordane	µg/kg dw	1.0 U	0.24 JN	1.0 U	1.0 U	0.24 J	1.6	0.25 JN	1.5 U	1.0 U	1.0 U	1.2	10	na
alpha-Endosulfan	µg/kg dw	1.0 U	1.0 U	1.0 U	1.0 U	0.21 J	1.0 U	1.0 UJ	1.0 U	2.3 U	1.0 U	1.0 U	na	na
beta-Endosulfan	µg/kg dw	1.0 U	1.0 U	1.0 U	3.0 U	0.54 J	10 J	1.0 UJ	1.0 U	6.3 U	1.0 U	1.0 U	na	na
Endosulfan sulfate	µg/kg dw	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	25	1.0 U	1.0 U	1.0 U	na	na
Endrin	µg/kg dw	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.5 J	1.0 U	1.0 U	1.7 U	1.0 U	1.0 U	na	na
Endrin ketone	µg/kg dw	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	6.0 U	1.2 U	1.5 J	62 J	1.2 J	1.0 U	na	na
gamma-BHC[b]	µg/kg dw	1.0 U	1.0 U	1.0 U	1.0 JN	1.0 U	1.3 J	0.18 JN	1.0 U	1.6 U	1.2	2.8 U	10	na
gamma-Chlordane	µg/kg dw	1.0 U	3.5 U	1.0 U	4.6 U	0.97 J	**16 J**	3.7 UJ	1.7 J	11 U	2.0 U	1.9	10	na
Methoxychlor	µg/kg dw	0.84 JN	1.0 U	1.0 U	1.0 U	5.0 J	3.1 U	1.0 UJ	1.0 U	22 U	1.0 U	1.0 U	na	na
Toxaphene	µg/kg dw	50 U	110 U	56 U	170 U	70 U	54 U	180 U	340 J	6,300 J	82 U	50 U	na	na

[a] Totals were calculated following rules described in Appendix B

[b] No SQS or CSL is available; concentration in sediment is compared to SL and ML.

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown; JN - analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification; reported concentration is an estimate

Bold indicates concentration or reporting limit above the SQS or SL; **Bold underlined** indicates concentration or reporting limit above the CSL or ML

na – neither SQS/SL nor CSL/ML is available

Table 4-24. Concentrations of PCBs as Aroclors and organochlorine pesticides detected in at least one sediment sample co-located with subtidal benthic invertebrate tissue samples compared to SQS/SL and CSL/ML

ANALYTE	UNITS	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b	SQS/SL	CSL/ML
Aroclor 1242	µg/kg dw	8.8 J	170	10 U	100	10 U	10 U	10 U	14 J	9.9 U	10 U	na	na
Aroclor 1248	µg/kg dw	15 U	140 U	10 U	84 U	68	120	10 U	10 U	9.9 U	10 U	na	na
Aroclor 1254	µg/kg dw	26	190	180	150	120	150	79	10 U	110	10 U	na	na
Aroclor 1260	µg/kg dw	26 J	150	170	150	90	150	88	23	100	9.8 J	na	na
Total PCBs[a]	µg/kg dw	61 J	510	350	400	280	420	170	37 J	210	9.8 J	na	na
Total PCBs (calc'd)[a]	mg/kg-OC	**12 J**	**55**	**19**	**14**	**20**	**14**	**13**	1.6 J	**12**	0.90 J	12	65
2,4'-DDD	µg/kg dw	1.0 U	3.5 U	2.3 U	19 U	7.0 J	2.2 U	1.0 U	1.0 U	1.8 U	1.0 U	na	na
2,4'-DDT	µg/kg dw	1.8 J	7.8	8.5	5.2 U	5.1	8.4	5.4	1.4	7.2 JN	0.65 J	na	na
4,4'-DDD	µg/kg dw	0.29 J	1.6	1.9	1.1	0.86 J	2.0 J	1.1	0.63 J	1.8 JN	0.39 J	na	na
4,4'-DDE	µg/kg dw	1.0 U	2.9 J	1.2 U	1.8	1.4 J	1.1 U	1.0 U	0.66 J	1.0 U	0.28 J	na	na
4,4'-DDT	µg/kg dw	1.6	9.8	11	3.4 J	6.5	12	13 J	2.5	8.2 JN	1.4 J	na	na
Total DDTs (calc'd)[a, b]	µg/kg dw	3.7 J	**22 J**	**21**	6.3 J	**21 J**	**22 J**	**20 J**	5.2 J	**17 JN**	2.7 J	6.9	69
Aldrin[b]	µg/kg dw	1.0 U	1.0 U	1.6	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	na	na
alpha-Chlordane	µg/kg dw	1.0 U	0.78 J	1.0 U	1.0 U	1.0 U	0.24 J	1.0 U	1.0 U	1.0 U	1.0 U	10	na
Endrin aldehyde	µg/kg dw	1.0 UJ	1.0 UJ	1.0 U	12 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	na	na
Endrin ketone	µg/kg dw	0.83 J	1.0 U	1.6 U	5.0 U	1.0 U	1.4 J	1.2 U	1.0 U	1.0 U	1.0 U	na	na
gamma-BHC[b]	µg/kg dw	1.0 U	0.61 J	1.0 U	1.0 U	0.36 J	1.0 U	1.0 U	1.0 U	1.0 U	2.1 U	10	na
gamma-Chlordane	µg/kg dw	1.0 U	7.1 J	6.2 U	2.7 U	1.0 U	4.5 U	3.2	1.3 U	3.8 JN	1.0 U	10	na
Heptachlor epoxide	µg/kg dw	0.47 J	2.1 U	1.0 U	1.2 U	4.9 J	1.1 U	1.0 U	1.0 U	1.0 U	1.0 U	na	na
Methoxychlor	µg/kg dw	1.0 U	1.0 U	1.0 U	1.1 U	1.0 U	1.3 U	1.0 U	1.0 U	1.0 UJ	1.0 U	na	na
Mirex	µg/kg dw	1.0 U	0.37 J	1.0 U	13 U	0.29 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	na	na

[a] Totals were calculated following rules described in Appendix B

[b] No SQS or CSL is available; concentration in sediment is compared to SL and ML.

Bold indicates concentration or reporting limit above the SQS or SL

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown; JN - analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification; reported concentration is an estimate

na – neither SQS/SL nor CSL/ML is available

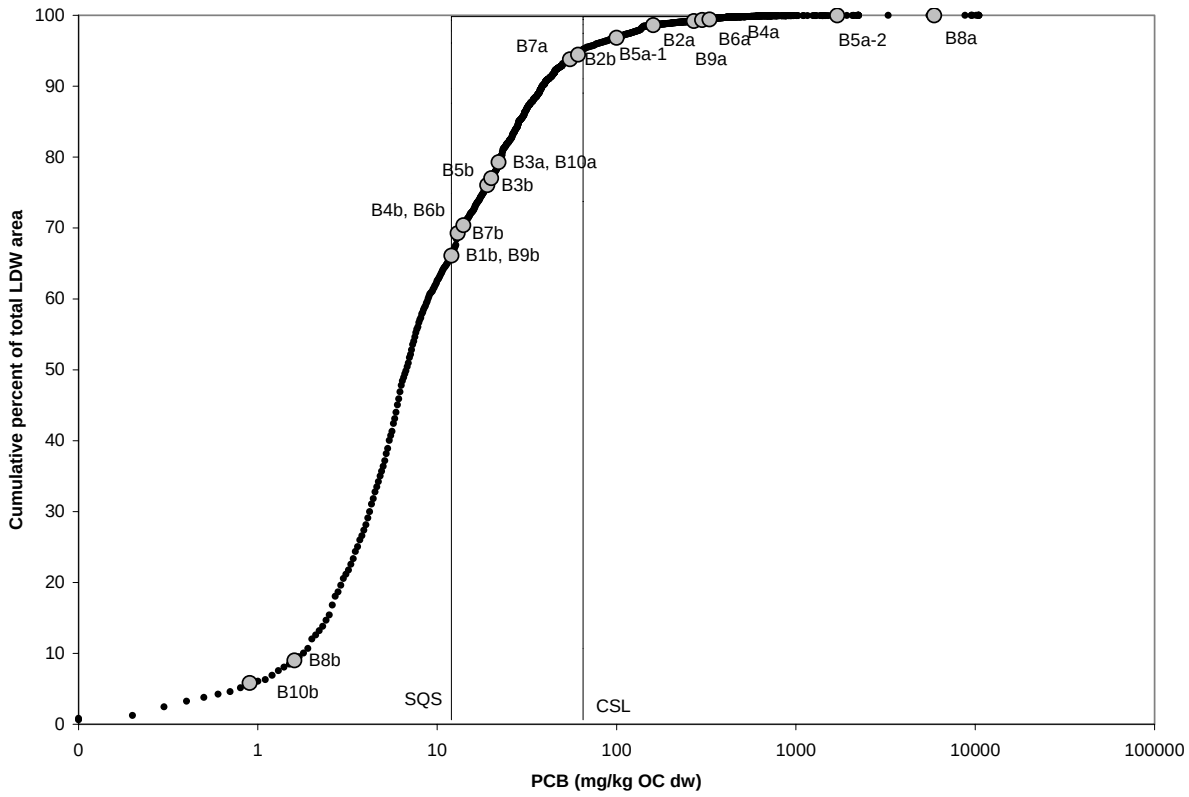

Figure 4-4. Cumulative frequency distribution of Phase I surface sediment PCB concentrations in the LDW and measured sediment concentrations at intertidal and subtidal benthic invertebrate stations in Phase 2

PCBs and organochlorine pesticides were detected in all intertidal and subtidal co-located sediment samples and are described in more detail, as follows:

- Aroclors 1242, 1248, 1254, and 1260 were detected in the sediments at one or more intertidal locations. Total PCB concentrations exceeded the SQS at intertidal locations B4a, B5a-1, B5a-2, B6a, B8a, and B9a. In addition, total PCB concentrations exceeded the CSL at intertidal locations B5a-2 and B8a.
- Aroclors 1242, 1248, 1254, and 1260 were detected in the sediments at one or more subtidal locations. Total PCB concentrations exceeded the SQS at all subtidal locations except B8b and B10b.
- Total DDT concentrations exceeded the SL at all intertidal locations except B1a and B3a. In addition, total DDT concentrations exceeded the ML at location B5a-2.
- Total DDT concentrations exceeded the SL at subtidal locations B2b, B3b, B5b, B6b, B7b, and B9b.
- The concentration of gamma-chlordane exceeded the SL for chlordane at intertidal location B5a-2.

4.1.5 Lipids and moisture in benthic invertebrate tissue samples

Table 4-25 presents percent lipid measured in the intertidal and subtidal benthic invertebrate tissue samples. Lipids ranged from 0.35% to 1.4% ww and moisture ranged from 83.4% to 95.9% ww.

Table 4-25. Percent lipid and moisture in benthic invertebrate tissue samples

ANALYTE	UNIT	B1a	B2a	B3a	B4a	B5a	B6a	B7a	B8a	B9a	B10a
Lipid	% ww	0.97	0.99	0.87	0.79	1.1	1.4	0.66	0.35	0.91	0.95
		B1b	**B2b**	**B3b**	**B4b**	**B5b**	**B6b**	**B7b**	**B8b**	**B9b**	**B10b**
		0.82	0.69	1.3	0.84	1.0 [a]	1.2	1.1	0.63	0.51	0.62
Moisture[b]	% ww	**B1a**	**B2a**	**B3a**	**B4a**	**B5a**	**B6a**	**B7a**	**B8a**	**B9a**	**B10a**
		91.71	90.27	90.25	90.61	84.8	84.3	93.30[a]	93.4	92.35	89.9
		B1b	**B2b**	**B3b**	**B4b**	**B5b**	**B6b**	**B7b**	**B8b**	**B9b**	**B10b**
		83.4	84.5	85.0	87.3	88.4	85.9	86.3	90.53 [a]	95.9	89.3

[a] Result shown is average of one or more laboratory replicate analyses

[b] Moisture is calculated as 100% - total solids

4.1.6 Grain size, TOC, and total solids in co-located sediment samples

Tables 4-26 and 4-27 present the results of grain size, TOC, and total solids analyses of intertidal and subtidal co-located sediment samples. The results are presented in full in Appendix A, Tables A-5 and A-6.

Table 4-26. Grain size, TOC, and total solids in sediment samples co-located with intertidal benthic invertebrate tissue samples

ANALYTE	B1a	B2a	B3a	B4a	B5a	B6a	B7a	B8a	B9a	B10a
Rocks (total calc'd) (% dw)	1.61	1.10	0.44	10.7	21.2	11.0	2.95	0.48	0.88	14.3
Sand (total calc'd) (% dw)	93.4	54.5	69.3	60.2	58.9	71.2	65.6	64.4	61.2	60.9
Silt (total calc'd) (% dw)	3.57	38.4	22.8	26.8	20.5	13.8	28.8	22.1	34.1	18.5
Clay (total calc'd) (% dw)	1.34	7.25	7.69	7.42	2.67	2.25	4.55	5.48	5.58	3.61
Fines (percent silt+clay) (% dw)	4.91	45.7	30.5	34.2	23.2	16.1	33.3	27.5	39.7	22.1
TOC (% dw)	1.70	1.97	1.36	1.96	1.40[a]	0.89	1.64	3.31	2.14	1.73
Total solids (% ww)	80.3	50.0	61.6	53.7	66.2[b]	71.2	51.7	53.6	52.4	63.0

[a] TOC in B5a-1 was 0.29%

[b] Total solids in B5a-1 was 77.1%

Table 4-27. Grain size, TOC, and total solids in sediment samples co-located with subtidal benthic invertebrate tissue samples

ANALYTE	B1b	B2b	B3b	B4b	B5b	B6b	B7b	B8b	B9b	B10b
Rocks (total calc'd) (% dw)	8.29	5.76	23.0	1.37	2.11	2.57	0.33	0.24	0.91	0.14
Sand (total calc'd) (% dw)	81.9	64.3	36.2	34.4	67.7	27.8	68.4	31.4	52.2	80.1
Silt (total calc'd) (% dw)	3.29	20.4	24.2	51.3	23.2	52.5	25.3	61.7	41.4	16.6
Clay (total calc'd) (% dw)	2.12	7.47	10.4	12.7	6.43	16.8	6.45	7.64	6.59	3.90
Fines (percent silt+clay) (% dw)	5.41	27.9	34.6	63.9	29.6	69.3	31.7	69.4	48.0	20.5
TOC (% dw)	0.50	0.93	1.82	2.79	1.39	2.96	1.30	2.36	1.74	1.09
Total solids (% ww)	75.2	66.4	66.4	45.9	57.8	47.9	52.0	47.0	54.2	59.1

Grain size, TOC, and total solids, results for the intertidal and subtidal co-located sediment samples are described in more detail, as follows:

- Sediments at intertidal locations B1a and B6a were coarse, with percent fines of 4.9% dw and 16% dw, respectively. All other intertidal locations except location B7a had medium grain-sized sediments, with percent fines ranging from 22% dw to 46% dw. Location B7a had fine sediment, with percent fines of 95% dw.
- Sediment at subtidal location B1b was coarse, with percent fines of 5.4% dw. All other subtidal locations except locations, B4b, B6b, and B8b, had medium grain-sized sediments with percent fines ranging from 21% to 48% dw. Locations B4b, B6b, and B8b had relatively fine sediments with percent fines ranging from 64% to 69.4% dw.
- TOC in intertidal samples ranged from 0.89% dw at location B6a to 3.31% dw at location B8a. In subtidal samples, TOC ranged from 0.50% dw at location B1b to 2.96% dw at location B6b.
- Total solids in intertidal samples ranged from 50.0% ww at location B2a to 80.3% dw at location B1a. In subtidal samples, total solids ranged from 45.9% ww at location B4b to 75.2% ww at location B1b.

4.1.7 Comparison of nondetected results to analytical concentration goals

The RLs for benthic tissue and co-located sediment samples were compared to their respective risk-based analytical concentration goals (ACGs) that were presented in Appendix C of the QAPP (Windward 2004b). The RLs for benthic invertebrate tissue samples were lower than the risk-based ACGs developed for benthic invertebrate tissue for all analytes except bis(2-ethylhexyl)phthalate. There were 15 benthic invertebrate tissue samples with RLs slightly above the ACGs.

The RLs for co-located sediment samples were lower than the applicable SQS or SL, except for the results summarized in Table 4-28. RLs for 35 results reported as undetected for five different chemicals were above the SQS/SL. Twenty-five of those results were also above the CSL/ML. Compared to the RLs, many fewer method

detection limits (MDLs) were above the SQS/SL and CSL/ML. Only two chemicals had MDLs above the SQS/SL, affecting only 4 samples. To reduce the uncertainty associated with these RLs, an additional eight sediment samples (B1a, B2a, B3a, B10a, B1b, B8b, B9b, and B10b) will be analyzed by GC/MS-SIM to achieve lower RLs. These results will be presented in an addendum to this data report.

Table 4-28. Number of reporting limits (RLs) and method detection limits (MDLs) above the SQS/SL and CSL/ML in sediment samples co-located with benthic invertebrate tissue samples

Chemical	Detection Frequency	Range of Detected Concentrations (µg/kg dw)	Range of RLs (µg/kg dw)	# of RLs above the SQS/SL	# of RLs above the CSL/ML	Range of MDLs (µg/kg dw)	# of MDLs above the SQS/SL	# of MDLs above the CSL/ML
1,2,4-Trichlorobenzene	0/20	na	8.6-50	11	2	1.9-14	0	0
1,2-Dichlorobenzene	0/20	na	8.6-50	1	1	1.7-13	0	0
2,4-Dimethylphenol	0/20	na	43-250	20	20	6.9-52	2	2
Benzoic acid	1/20	250	180-1,000	2	2	120-900	2	2
Phenol	10/20	19J-2,800	7.3-1,100	1	0	2.6-15	0	0
Total				**35**	**25**		**4**	**4**

4.2 CLAM AND CO-LOCATED SEDIMENT RESULTS

All 14 of the clam tissue samples collected from the LDW were analyzed for metals, TBT, SVOCs, PCBs as Aroclors, organochlorine pesticides, percent lipids, and moisture. Eight of those samples (C1, C2-T1, C3-T1, C4, C5, C6, C7-T2, and C9) were also analyzed for inorganic arsenic. All 14 of the co-located sediment samples from the LDW were analyzed for metals, TBT, SVOCs, PCBs as Aroclors, organochlorine pesticides, TOC, total solids, and grain size. All 12 of the clam tissue samples collected at the background locations were analyzed only for total arsenic, inorganic arsenic, percent lipids, and moisture. All 12 of the co-located sediment samples from the background locations were analyzed only for total arsenic and total solids. The results of these analyses are discussed separately below under each analyte group.

Eight of the 14 co-located clam tissue and sediment samples collected from the LDW are also being analyzed for all 209 PCB congeners by Axys. The locations are LDW-C1, LDW-C2-2, LDW-C4, LDW-C6, LDW-C7-1, LDW-C8, LDW-C9, LDW-C10-1. These locations were selected, in consultation with EPA and Ecology, to provide PCB congener analyses over the range of total PCB concentrations in clam samples, and to provide spatial coverage of locations within the LDW. The PCB congener concentrations in these samples will be reported in an addendum to this data report.

4.2.1 Metals

The results from the metal analyses of clam tissue and co-located sediment samples are presented in Sections 4.2.1.1 and 4.2.1.2.

4.2.1.1 Clam tissue

Table 4-29 presents a summary of the metals analyzed in clam tissue samples, including the number of detections, the range of detected metals concentrations, and the range of reporting limits. Results for all metals detected are presented in Tables 4-30 and 4-31 and in Appendix A, Table A-7.

Table 4-29. Summary of metals concentrations in clam tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (mg/kg ww)	Maximum Detected Concentration (mg/kg ww)	Minimum Reporting Limit (mg/kg ww)	Maximum Reporting Limit (mg/kg ww)
LDW samples					
Antimony	14/14	0.007	0.252	na	na
Arsenic (total)	14/14	1.300 J	5.870 J	na	na
Arsenic (inorganic)	8/8	0.132	3.27	na	na
Cadmium	14/14	0.064	0.148	na	na
Chromium	14/14	0.36	1.32	na	na
Cobalt	14/14	0.1470	0.7110	na	na
Copper	14/14	3.50	7.30	na	na
Lead	14/14	0.368	6.370	na	na
Mercury	14/14	0.009	0.022	na	na
Molybdenum	14/14	0.1750	0.3610	na	na
Nickel	14/14	0.313	1.090	na	na
Selenium	14/14	0.215	0.373	na	na
Silver	14/14	0.012	0.093	na	na
Thallium	14/14	0.0009	0.0042	na	na
Vanadium	14/14	0.68	2.65	na	na
Zinc	14/14	16.1	32.3	na	na
Background area samples (Fay Bainbridge State Park)					
Arsenic (total)	6/6	1.69	2.83	na	na
Arsenic (inorganic)	6/6	0.044 J	0.446 J	na	na
Background area samples (Seahurst Park)					
Arsenic (total)	6/6	1.09	2.25	na	na
Arsenic (inorganic)	6/6	0.098 J	0.616 J	na	na

Data qualifier: J - estimated concentration

na – not applicable

Table 4-30. Concentrations of metals (mg/kg ww) detected in LDW clam tissue samples

ANALYTE	C1	C2-T1	C2-T2	C3-T1	C3-T2	C4	C5	C6	C7-T1	C7-T2	C8	C9	C10-T1	C10-T2
Antimony	0.011	0.010	0.007	0.062	0.096	0.252	0.029	0.052	0.022	0.023	0.072	0.010	0.043	0.026
Arsenic (total)	1.300 J	1.840 J	1.875 J	2.010J	4.640 J	5.870 J	2.280 J	2.730 J	2.820 J	3.860 J	5.440 J	1.480 J	4.070 J	2.810 J
Arsenic (inorganic)	0.132	0.648	na	0.885	na	3.27	0.795	1.85	na	2.11	na	0.233	na	na
Cadmium	0.123	0.064	0.087	0.124	0.080	0.083	0.100	0.069	0.124	0.111	0.148	0.122	0.066	0.092
Chromium	0.54	0.36	0.59	0.58	0.93	0.77	0.70	0.38	0.88	0.75	1.32	0.49	0.57	0.48
Cobalt	0.2820	0.1470	0.2445	0.2740	0.2710	0.3300	0.3150	0.3560	0.2630	0.2560	0.3530	0.2640	0.7110	0.6220
Copper	6.03	4.00	6.74	7.30	6.24	6.27	6.41	3.50	4.12	4.02	5.39	6.59	4.20	3.96
Lead	0.446	0.368	0.384	3.940	4.570	1.700	1.970	2.310	1.130	1.140	6.370	1.590	0.877	0.597
Mercury	0.015	0.011	0.009	0.016	0.020	0.018	0.018	0.014	0.015	0.014	0.022	0.020	0.019	0.019
Molybdenum	0.2280	0.1990	0.2315	0.2130	0.2320	0.2550	0.2890	0.1750	0.2190	0.2080	0.3070	0.2340	0.3610	0.3100
Nickel	0.539	0.313	0.702	0.539	0.744	0.490	0.542	0.590	0.642	0.614	1.090	0.480	0.573	0.493
Selenium	0.313	0.259	0.269	0.261	0.292	0.269	0.373	0.215	0.261	0.237	0.239	0.318	0.301	0.294
Silver	0.021	0.019	0.025	0.013	0.016	0.038	0.026	0.012	0.056	0.056	0.093	0.060	0.031	0.028
Thallium	0.0009	0.0011	0.0014	0.0014	0.0021	0.0011	0.0014	0.0010	0.0013	0.0020	0.0042	0.0011	0.0019	0.0014
Vanadium	0.69	1.05	1.03	1.08	1.65	1.20	1.24	1.07	1.15	1.33	2.65	0.68	1.61	1.13
Zinc	19.3	16.1	22.8	23.5	30.1	27.7	22.7	19.1	24.6	21.6	32.3	27.1	20.6	24.9

Data qualifier: J - estimated concentration

na – not analyzed

Table 4-31. Concentrations of arsenic (mg/kg ww) detected in background area clam tissue samples

ANALYTE	BI-C-T1	BI-C-T2	BI-C-T3	BI-C-T4	BI-C-T5	BI-C-T6	SP-C-T1	SP-C-T2	SP-C-T3	SP-C-T4	SP-C-T5	SP-C-T6
Arsenic (total)	2.55	2.83	1.70	2.31	2.35	1.89	1.09	2.25	2.11	2.04	2.13	1.98
Arsenic (inorganic)	0.074 J	0.085 J	0.069 J	0.446 J	0.044 J	0.331 J	0.098 J	0.616 J	0.537 J	0.536 J	0.541 J	0.485 J

Data qualifier: J - estimated concentration

Metals were detected in all clam tissue samples and are described in more detail, as follows:

- All metals were detected in all clam tissue samples. The highest concentrations of metals were detected at the following locations: C3-T1—copper; C4—antimony, arsenic, and inorganic arsenic; C5—selenium; C8—cadmium, chromium, lead, mercury, nickel, silver, thallium, vanadium, and zinc; and C10-T1—cobalt and molybdenum.
- Total arsenic concentrations in clam samples from the LDW ranged from 1.300 J mg/kg ww at location C1 to 5.870 J mg/kg ww at location C4. Inorganic arsenic concentrations ranged from 0.132 mg/kg ww at location C1 to 3.27 mg/kg ww at location C4.
- Total arsenic concentrations in clam samples from the two background areas ranged from 1.09 mg/kg ww to 2.83 mg/kg ww. Concentrations were similar in the two areas. Inorganic arsenic concentrations ranged from 0.044 mg/kg ww to 0.616 mg/kg ww. Maximum concentrations were slightly higher at Seahurst Park compared to Fay Bainbridge State Park (Table 4-31).

4.2.1.2 Sediment co-located with clam tissue samples

Table 4-32 presents a summary of the metals analyzed in the co-located sediment samples, including the number of detections, the range of detected metals concentrations, and the range of reporting limits. Results for all metals detected in sediment samples are presented in Table 4-33 and 4-34, and compared to SQS/SL and CSL/ML. The results are also presented in Appendix A, Table A-8.

Table 4-32. Summary of metals concentrations in sediment samples co-located with clam tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (mg/kg dw)	Maximum Detected Concentration (mg/kg dw)	Minimum Reporting Limit (mg/kg dw)	Maximum Reporting Limit (mg/kg dw)
LDW samples					
Antimony	14/14	0.15 J	20.2 J	na	na
Arsenic	14/14	3.13	49	na	na
Cadmium	14/14	0.05	1.4	na	na
Chromium	14/14	9.1	27.4	na	na
Cobalt	14/14	2.82	7.92	na	na
Copper	14/14	14.8	118	na	na
Lead	14/14	7.94 J	181 J	na	na
Mercury	14/14	0.021	0.211	na	na
Molybdenum	14/14	0.390 J	3.710 J	na	na
Nickel	14/14	6.31	19.6	na	na
Selenium	14/14	0.3	0.6	na	na

Analyte	Detection Frequency	Minimum Detected Concentration (mg/kg dw)	Maximum Detected Concentration (mg/kg dw)	Minimum Reporting Limit (mg/kg dw)	Maximum Reporting Limit (mg/kg dw)
Silver	14/14	0.040	0.980	na	na
Thallium	14/14	0.036	0.111	na	na
Vanadium	14/14	31.1	65.1	na	na
Zinc	14/14	36.4 J	275 J	na	na
Background area samples (Fay Bainbridge State Park)					
Arsenic	6/6	1.39	1.63	na	na
Background area samples (Seahurst Park)					
Arsenic	6/6	1.34	1.76	na	na

Data qualifier: J - estimated concentration

na – not applicable

Table 4-33. Concentrations of metals (mg/kg dw) in sediment samples co-located with LDW clam tissue samples compared to SQS/SL and CSL/ML

ANALYTE	C1	C2-S1	C2-S2	C3-S1	C3-S2	C4	C5	C6	C7-S1	C7-S2	C8	C9	C10-S1	C10-S2	SQS/SL	CSL/ML
Antimony [a]	0.21 J	0.76 J	0.15 J	2.28 J	1.08 J	20.2 J	0.67 J	2.04 J	6.12 J	0.33 J	2.64 J	0.45 J	2.17 J	0.79 J	150	200
Arsenic	3.53	5.79	3.13	4.63	3.62	49.0	4.72	5.52	6.17	6.80	10.5	3.94	11.9	10.8	57	93
Cadmium	0.050	0.140	0.110	0.220	0.180	0.200	0.070	0.120	0.310	0.190	1.40	0.060	0.210	0.160	5.1	6.7
Chromium	9.10	11.4	9.84	12.2	10.6	19.9	10.4	12.0	11.6	13.1	27.4	12.2	17.4	14.7	260	270
Cobalt	3.83	3.26	3.07	3.12	2.82	5.43	3.92	3.91	3.99	4.24	5.78	3.88	7.92	7.37	na	na
Copper	17.6	21.6	14.8	98.5	21.9	118	17.4	22.1	22.0	20.9	54.0	18.0	26.7	22.9	390	390
Lead	13.1 J	10.9 J	7.94 J	134 J	51.0 J	59.6 J	22.5 J	91.5 J	32.0 J	17.5 J	181 J	51.2 J	34.2 J	33.0 J	450	530
Mercury	0.053	0.041	0.066	0.047	0.029	0.051	0.021	0.038	0.030	0.039	0.211	0.076	0.042	0.036	0.41	0.59
Molybdenum	0.494 J	1.250 J	0.666 J	0.455 J	0.537 J	3.710 J	0.495 J	0.543 J	1.150 J	0.390 J	2.430 J	0.486 J	0.994 J	0.902 J	na	na
Nickel [a]	7.52	6.40	6.31	8.36	8.73	9.73	11.3	8.96	13.1	13.6	19.6	11.3	14.3	11.4	140	370
Selenium	0.4	0.6	0.4	0.4	0.3	0.5	0.3	0.4	0.4	0.4	0.6	0.3	0.6	0.6	na	na
Silver	0.040	0.164	0.117	0.094	0.073	0.485	0.077	0.083	0.510	0.139	0.980	0.084	0.157	0.155	6.1	6.1
Thallium	0.036	0.064	0.049	0.054	0.054	0.053	0.044	0.047	0.050	0.053	0.079	0.037	0.060	0.111	na	na
Vanadium	44.2	44.7	43.7	39.6	34.8	43.5	41.5	45.1	45.9	31.1	54.9	41.8	64.8	65.1	na	na
Zinc	42.6 J	45.8 J	36.4 J	199 J	148 J	236 J	70.4 J	64.8 J	101 J	60.3 J	275 J	55.8 J	136 J	143 J	410	960

[a] No SQS or CSL is available; concentration in sediment compared to SL and ML

Data qualifier: J - estimated concentration

SQS/SL and CSL/ML values are provided for comparative purposes in this data report; these standards have no relevance to bioaccumulation in clams

Dry weight concentrations for OC-normalized results are presented in Appendix Ana – neither SQS/SL nor CSL/ML is available

Table 4-34. Concentrations of arsenic (mg/kg dw) in sediment samples co-located with background area clam tissue samples compared to SQS and CSL

ANALYTE	BI-C-S1	BI-C-S2	BI-C-S3	BI-C-S4	BI-C-S5	BI-C-S6	SP-C-S1	SP-C-S2	SP-C-S3	SP-C-S4	SP-C-S5	SP-C-S6	SQS	CSL
Arsenic	1.39	1.58	1.61	1.63	1.60	1.53	1.76	1.30	1.42	1.64	1.69	1.45	57	93

Metals were detected in all sediment samples collected with clam tissue samples and are described in more detail, as follows:

- All metals were detected in all sediment samples. None of the metal concentrations exceeded their SQS/SL.
- Total arsenic concentrations in the LDW samples ranged from 3.13 mg/kg dw at location C2-S2 to 49 mg/kg dw at location C4. The total arsenic concentrations in the background area samples ranged from 1.30 mg/kg dw to 1.76 mg/kg dw. Concentrations were very similar in the two background areas.

4.2.2 Butyltins

The results from the analyses of butyltins in clam tissue and co-located sediment samples are presented in Sections 4.2.2.1 and 4.2.2.2.

4.2.2.1 Clam tissue

Table 4-35 presents a summary of the butyltins analyzed in clam tissue samples, including the number of detections, the range of detected butyltin concentrations, and the range of reporting limits. Results for all butyltins in clam tissue samples are presented in Table 4-36 and in Appendix A, Table A-7. TBT was detected in all the clam tissue samples. The highest TBT concentration in clam tissue samples (660 µg/kg ww) was reported for clams from location C5.

Table 4-35. Summary of butyltin concentrations in clam tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
Monobutyltin as ion	14/14	0.57 J	2.5	na	na
Dibutyltin as ion	13/14	1.8	10 J	3.9	3.9
Tributyltin as ion	14/14	150	660	na	na
Tetrabutyltin as ion	0/14	nd	nd	0.97	1.0

Data qualifier: J - estimated concentration

na – not applicable

nd – not detected

Table 4-36. Concentrations of butyltin (µg/kg ww) in clam tissue samples collected in the LDW

ANALYTE	C1	C2-T1	C2-T2	C3-T1	C3-T2	C4	C5	C6	C7-T1	C7-T2	C8	C9	C10-T1	C10-T2
Monobutyltin as ion	1.4	1.1	1.0 J	0.78 J	1.0	1.9	2.5	0.57 J	0.79 J	0.65 J	2.2	0.72 J	1.5	1.3
Dibutyltin as ion	3.7 J	2.4	3.5 J	1.8	4.0 J	3.9 U	10 J	1.9	3.3	2.6	4.9 J	4.1	5.4 J	4.4 J
Tributyltin as ion	350	200	270	290	300	560	660	160	210	160	150	420	390	420
Tetrabutyltin as ion	0.98 U	0.99 U	1.0 U	0.99 U	0.99 U	1.0 U	0.99 U	0.98 U	0.98 U	0.98 U	1.0 U	0.97 U	0.98 U	1.0 U

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

4.2.2.2 Sediment samples co-located with clam tissue samples

Table 4-37 presents a summary of the butyltins analyzed in sediment samples co-located with clam tissue samples, including the number of detections, the range of detected butyltin concentrations, and the range of reporting limits. Results for all butyltins in sediment samples collected with clam tissue samples are presented in Table 4-38 and in Appendix A, Table A-8. TBT was detected in all the sediment samples collected with clam tissue samples. The highest TBT concentration (7.0 µg/kg dw) was reported from sediment collected from location C8.

Table 4-37. Summary of butyltin concentrations in sediment samples co-located with clam tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
Monobutyltin as ion	14/14	0.31 J	5.9	na	na
Dibutyltin as ion	14/14	0.42 J	9.8	na	na
Tributyltin as ion	14/14	0.28 J	7.0	na	na
Tetrabutyltin as ion	0/14	nd	nd	1.3	2.0

Data qualifier: J - estimated concentration

na – not applicable

nd – not detected

Table 4-38. Concentrations of butyltins (µg/kg dw) in sediment samples co-located with clam tissue samples

ANALYTE	C1	C2-S1	C2-S2	C3-S1	C3-S2	C4	C5	C6	C7-S1	C7-S2	C8	C9	C10-S1	C10-S2
Monobutyltin as ion	0.31 J	0.66 J	1.2	1.4	0.64 J	2.0	0.85 J	2.3	0.63 J	0.68 J	5.9	0.60 J	2.5	1.2 J
Dibutyltin	0.43 J	2.5	1.2 J	0.83 J	0.42 J	3.1	2.9	1.4 J	1.9	1.5	9.8	1.3 J	2.8	1.6 J
Tributyltin	0.28 J	4.3	1.2 J	0.74 J	0.39 J	3.4	6.5	1.8	2.0	1.1 J	7.0	1.3 J	3.8	2.7
Tetrabutyltin	1.4 U	1.8 U	1.5 U	1.4 U	1.4 U	1.5 U	1.4 U	1.5 U	1.3 U	1.3 U	1.7 U	1.4 U	2.0 U	2.0 U

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

4.2.3 SVOCs

The results from the SVOC analyses of clam tissue and co-located sediment samples are presented in Sections 4.2.3.1 and 4.2.3.2.

4.2.3.1 Clam tissue

Table 4-39 presents a summary of the SVOCs analyzed in clam tissue samples, including the number of detections, the range of detected SVOC concentrations, and the range of reporting limits. Results for all SVOCs detected in at least one clam tissue sample are presented in Table 4-40. The results are presented in full in Appendix A, Table A-7.

Table 4-39. Summary of SVOC concentrations in clam tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
PAHs					
2-Chloronaphthalene	0/14	nd	nd	39	40
2-Methylnaphthalene	14/14	0.41 J	1.9	na	na
Acenaphthene	14/14	0.82	7.6	na	na
Acenaphthylene	14/14	0.56	1.9	na	na
Anthracene	14/14	1.8	8.0	na	na
Benzo(a)anthracene	14/14	12	42	na	na
Benzo(a)pyrene	14/14	3.0	26	na	na
Benzo(b)fluoranthene	14/14	7.3	44	na	na
Benzo(g,h,i)perylene	14/14	3.3	32	na	na
Benzo(k)fluoranthene	14/14	6.2	38	na	na
Total benzofluoranthenes (calc'd)[a]	14/14	13.5	82	na	na
Chrysene	14/14	20	85	na	na
Dibenzo(a,h)anthracene	14/14	0.63	5.1	na	na
Dibenzofuran	14/14	0.61	2.8	na	na
Fluoranthene	14/14	34	120	na	na
Fluorene	14/14	0.81	4.6	na	na
Indeno(1,2,3-cd)pyrene	14/14	2.1	28	na	na
Naphthalene	1/14	0.8 J	0.8 J	0.57	1.6
Phenanthrene	14/14	4.0	26	na	na
Pyrene	14/14	34	130	na	na
Total HPAH (calc'd)[a]	14/14	132	550	na	na
Total LPAH (calc'd)[a]	14/14	8.2	48	na	na
Phthalates					
Bis(2-ethylhexyl)phthalate	10/14	56 J	220 J	490	500
Butyl benzyl phthalate	0/14	nd	nd	39	40
Diethyl phthalate	2/14	9.5 J	14 J	77	80

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
Dimethyl phthalate	0/14	nd	nd	39	40
Di-n-butyl phthalate	4/14	19 J	34 J	39	40
Di-n-octyl phthalate	0/14	nd	nd	39	40
Other SVOCs					
1,2-Dichlorobenzene	0/14	nd	nd	39	40
1,3-Dichlorobenzene	0/14	nd	nd	39	40
1,4-Dichlorobenzene	0/14	nd	nd	39	40
1,2,4-Trichlorobenzene	0/14	nd	nd	39	40
2,4,5-Trichlorophenol	0/14	nd	nd	77	80
2,4,6-Trichlorophenol	0/14	nd	nd	77	80
2,4-Dichlorophenol	0/14	nd	nd	77	80
2,4-Dimethylphenol	0/14	nd	nd	77	80
2,4-Dinitrophenol	0/14	nd	nd	770	800
2,4-Dinitrotoluene	0/14	nd	nd	77	80
2,6-Dinitrotoluene	0/14	nd	nd	39	40
2-Chlorophenol	0/14	nd	nd	77	80
2-Methylphenol	0/14	nd	nd	77	80
2-Nitroaniline	0/14	nd	nd	200	200
2-Nitrophenol	0/14	nd	nd	39	40
3,3'-Dichlorobenzidine	0/14	nd	nd	2,000	2,000
3-Nitroaniline	0/14	nd	nd	390	400
4,6-Dinitro-o-cresol	0/14	nd	nd	390	400
4-Bromophenyl phenyl ether	0/14	nd	nd	39	40
4-Chloro-3-methylphenol	0/14	nd	nd	200	200
4-Chloroaniline	0/14	nd	nd	200	200
4-Chlorophenyl phenyl ether	0/14	nd	nd	39	40
4-Methylphenol	7/14	15 J	41 J	77	80
4-Nitroaniline	0/14	nd	nd	200	200
4-Nitrophenol	0/14	nd	nd	390	400
Aniline	0/14	nd	nd	770	800
Benzidine	0/14	nd	nd	5,000	5,000
Benzoic acid	14/14	340 J	640 J	na	na
Benzyl alcohol	0/14	nd	nd	39	40
bis(2-chloroethoxy)methane	0/14	nd	nd	39	40
bis(2-chloroethyl)ether	0/14	nd	nd	39	40
bis(2-chloroisopropyl)ether	0/14	nd	nd	39	40
Carbazole	0/14	nd	nd	200	200
Hexachlorobenzene	9/14	0.38 J	1.0 J	1.0	1.0
Hexachlorobutadiene	0/14	nd	nd	39	40
Hexachlorocyclopentadiene	0/14	nd	nd	5,000	5,000

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
Hexachloroethane	0/14	nd	nd	39	40
Isophorone	0/14	nd	nd	39	40
Nitrobenzene	0/14	nd	nd	39	40
N-Nitrosodimethylamine	0/14	nd	nd	39	40
N-Nitroso-di-n-propylamine	0/14	nd	nd	39	40
N-Nitrosodiphenylamine	0/14	nd	nd	39	40
Pentachlorophenol	0/14	nd	nd	390	400
Phenol	12/14	18 J	50 J	97	100

[a] Totals were calculated following rules described in Appendix B

Data qualifier: J - estimated concentration

na – not available

nd – not detected

Table 4-40. Concentrations of SVOCs (µg/kg ww) detected in at least one clam tissue sample

ANALYTE	C1	C2-T1	C2-T2	C3-T1	C3-T2	C4	C5	C6	C7-T1	C7-T2	C8	C9	C10-T1	C10-T2
PAHs														
2-Methylnaphthalene	0.87 J	0.73 J	0.77 J	1.1	1.1	0.90 J	0.88 J	0.66 J	0.77 J	0.79 J	1.9	0.69 J	0.41 J	0.44 J
Acenaphthene	1.1	0.97	1.2	1.8	1.5	1.5	3.0	1.8	2.6	2.2	7.6	1.6	0.82	1.2
Acenaphthylene	0.68	0.60	0.83	1.2	1.1	1.5	1.9	0.96	1.6	1.1	1.5	1.3	0.61	0.56
Anthracene	2.7	2.0	2.9	3.7	3.4	3.7	7.2	3.4	5.6	4.3	8.0	4.8	1.8	1.8
Benzo(a)anthracene	21	15	19	21	19	23	39	21	31	23	42	26	12	12
Benzo(a)pyrene	6.2	3.0	4.6	5.4	4.8	7.3	13	5.2	14	9.8	26	7.2	4.6	4.3
Benzo(b)fluoranthene	14	7.8	9.5	11	11	13	23	11	24	21	44	14	8.2	7.3
Benzo(g,h,i)perylene	6.1	3.3	4.5	6.0	5.5	8.6	12	5.3	16	15	32	8.0	8.0	7.1
Benzo(k)fluoranthene	12	6.8	8.9	9.8	9.8	11	18	8.4	22	18	38	12	6.5	6.2
Total benzofluoranthenes (calc'd)[a]	26	14.6	18.4	21	21	24	41	19	46	39	82	26	14.7	13.5
Chrysene	37	27	31	39	36	42	63	34	58	52	85	44	20	20
Dibenzo(a,h)anthracene	1.4	0.81	1.0	1.2	0.63	1.2	1.4	0.74	1.7	1.9	5.1	0.85	1.3	0.65
Dibenzofuran	1.0	0.84	1.1	1.3	1.4	1.2	2.3	1.6	1.6	1.5	2.8	1.3	0.61	0.62
Fluoranthene	57	48	59	74	74	65	110	62	88	84	120	74	34	37
Fluorene	1.5	1.2	1.5	2.1	2.1	1.9	3.7	2.0	2.6	2.3	4.6	1.8	0.93	0.81
Indeno(1,2,3-cd)pyrene	3.9	2.1	2.3	3.3	2.7	4.7	5.4	3.0	8.6	10	28	4.0	3.1	2.8
Naphthalene	0.79 UJ	0.71 UJ	0.80 J	0.83 UJ	0.91 UJ	1.0 U	0.96 UJ	0.80 UJ	0.90 UJ	0.80 UJ	1.6 U	0.78 UJ	0.57 UJ	0.59 UJ
Phenanthrene	9.0	6.7	7.3	11	11	9.2	19	10	13	11	26	10	4.0	4.4
Pyrene	48	39	48	61	62	57	97	54	81	81	130	66	34	36
Total HPAH (calc'd)[a]	207	153	188	232	225	233	380	205	344	316	550	256	132	133
Total LPAH (calc'd)[a]	15	11.5	14.5 J	20	19	17.8	35	18	25	21	48	20	8.2	8.8
Phthalates														
Bis(2-ethylhexyl)phthalate	67 J	490 U	72 J	490 U	56 J	120 J	500 U	86 J	84 J	100 J	220 J	120 J	56 J	500 U
Diethyl phthalate	78 U	78 U	14 J	77 U	78 U	9.5 J	79 U	77 U	80 U	80 U	77 U	78 U	80 U	80 U
Di-n-butyl phthalate	32 J	34 J	40 U	39 U	39 U	40 U	40 U	39 U	40 U	19 J	33 J	39 U	40 U	40 U

ANALYTE	C1	C2-T1	C2-T2	C3-T1	C3-T2	C4	C5	C6	C7-T1	C7-T2	C8	C9	C10-T1	C10-T2
Other SVOCs														
4-Methylphenol	78 U	78 U	20 J	77 U	78 U	23 J	79 U	24 J	20 J	41 J	32 J	78 U	15 J	80 U
Benzoic acid	600 J	430 J	530 J	340 J	360 J	600 J	430 J	440 J	640 J	420 J	340 J	450 J	500 J	460 J
Hexachlorobenzene	1.0 U	1.0 UJ	0.61 J	1.0 U	0.50 J	0.77 J	0.88 J	0.96 J	1.0 J	0.38 J	1.0 U	1.0 U	0.75 J	0.91 J
Phenol	19 J	20 J	23 J	97 U	18 J	50 J	18 J	23 J	29 J	30 J	36 J	24 J	35 J	100 U

[a] Totals were calculated following rules described in Appendix B

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown

SVOCs were detected in all clam tissue samples and are described in more detail, as follows:

- A total of 25 SVOCs were detected in clam tissue samples, with the highest number of SVOCs detected at location C2-T1 (24)
- Total LPAH ranged from 8.2 to 48 µg/kg ww and total HPAH ranged from 132 to 550 µg/kg ww
- Three phthalates were detected in the clam tissue samples:
  - bis(2-ethylhexyl)phthalate was detected at all locations except C2-T1, C3-T1, C5, and C10-T2, at concentrations ranging from 56 to 220 µg/kg ww
  - diethyl phthalate was detected at locations C2-T2 and C4 at concentrations of 14 µg/kg ww and 9.5 µg/kg ww, respectively
  - di-*n*-butyl phthalate was detected at locations C1, C2-T1, C7-T2, and C8 at concentrations ranging from 19 µg/kg ww to 34 µg/kg ww
- Four other SVOCs were measured in clam tissue samples, with benzoic acid measured at the highest concentration (640 J µg/kg ww at location C7-T1).

4.2.3.2 Sediment samples co-located with clam tissue samples

Table 4-41 presents a summary of the SVOCs analyzed in sediment samples co-located with clam tissue samples, including the number of detections, the range of detected SVOC concentrations, and the range of reporting limits. Results for all SVOCs detected in at least one sediment sample co-located with clam tissue samples are presented in Table 4-42, and compared to SQS and CSL. Concentrations in bold text are above the SQS. Concentrations in bold underlined text are above the CSL. Reporting limits that exceed the applicable SQS and CSL are discussed in Section 4.2.7. The results are presented in full in Appendix A, Table A-8.

Table 4-41. Summary of SVOC concentrations in sediment samples co-located with clam tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
PAHs					
2-Chloronaphthalene	0/14	nd	nd	20	100
2-Methylnaphthalene	14/14	1.7 J	43	na	na
Acenaphthene	14/14	1.1 J	530	na	na
Acenaphthylene	14/14	1.3 J	77	na	na
Anthracene	14/14	3.6 J	650	na	na
Benzo(a)anthracene	14/14	7.6	3,100	na	na
Benzo(a)pyrene	14/14	8.4	4,900	na	na
Benzo(b)fluoranthene	14/14	12	4,600	na	na

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
Benzo(g,h,i)perylene	14/14	7.8	3,800	na	na
Benzo(k)fluoranthene	14/14	8.4	3,500	na	na
Total benzofluoranthenes (calc'd)[a]	14/14	20	8,100	na	na
Chrysene	14/14	12	3,600	na	na
Dibenzo(a,h)anthracene	14/14	1.6 J	1,500	na	na
Dibenzofuran	14/14	1.3 J	87	na	na
Fluoranthene	14/14	18	5,500	na	na
Fluorene	14/14	1.4 J	190	na	na
Indeno(1,2,3-cd)pyrene	14/14	7.6	4,300	na	na
Naphthalene	14/14	3.8 J	44	na	na
Phenanthrene	14/14	7.9	2,200	na	na
Pyrene	14/14	23	5,300	na	na
Total HPAH (calc'd)[a]	14/14	106 J	40,100	na	na
Total LPAH (calc'd)[a]	14/14	19.9 J	3,700	na	na
Phthalates					
Bis(2-ethylhexyl)phthalate	14/14	12 J	2,500	na	na
Butyl benzyl phthalate	3/14	7.0 J	220	20	100
Diethyl phthalate	0/14	nd	nd	20	100
Dimethyl phthalate	0/14	nd	nd	20	100
Di-n-butyl phthalate	4/14	7.2 J	380	20	100
Di-n-octyl phthalate	4/14	30 J	160	20	100
Other SVOCs					
1,2-Dichlorobenzene	0/14	nd	nd	20	100
1,3-Dichlorobenzene	0/14	nd	nd	20	100
1,4-Dichlorobenzene	0/14	nd	nd	20	100
1,2,4-Trichlorobenzene	0/14	nd	nd	20	100
2,4,5-Trichlorophenol	0/14	nd	nd	20	100
2,4,6-Trichlorophenol	0/14	nd	nd	20	100
2,4-Dichlorophenol	0/14	nd	nd	20	100
2,4-Dimethylphenol	0/14	nd	nd	96	500
2,4-Dinitrophenol	0/14	nd	nd	390	2,000
2,4-Dinitrotoluene	0/14	nd	nd	20	100
2,6-Dinitrotoluene	0/14	nd	nd	20	100
2-Chlorophenol	0/14	nd	nd	20	100
2-Methylphenol	0/14	nd	nd	20	100
2-Nitroaniline	0/14	nd	nd	39	200
2-Nitrophenol	0/14	nd	nd	20	100
3,3'-Dichlorobenzidine	0/14	nd	nd	200	1,000
3-Nitroaniline	0/14	nd	nd	39	200
4,6-Dinitro-o-cresol	0/14	nd	nd	200	1,000

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
4-Bromophenyl phenyl ether	0/14	nd	nd	20	100
4-Chloro-3-methylphenol	1/14	6.4 J	6.4 J	20	100
4-Chloroaniline	0/14	nd	nd	20	100
4-Chlorophenyl phenyl ether	0/14	nd	nd	20	100
4-Methylphenol	6/14	8.7 J	160	20	100
4-Nitroaniline	0/14	nd	nd	39	200
4-Nitrophenol	0/14	nd	nd	200	1,000
Aniline	0/14	nd	nd	39	200
Benzidine	0/1	nd	nd	1,400	1,400
Benzoic acid	0/14	nd	nd	390	2,000
Benzyl alcohol	1/14	23	23	20	100
bis(2-chloroethoxy)methane	0/14	nd	nd	20	100
bis(2-chloroethyl)ether	0/14	nd	nd	20	100
bis(2-chloroisopropyl)ether	0/14	nd	nd	20	100
Carbazole	11/14	4.1 J	2,100	20	50
Hexachlorobenzene	3/14	0.80 J	4.3	0.97	1.3
Hexachlorobutadiene	0/14	nd	nd	20	100
Hexachlorocyclopentadiene	0/14	nd	nd	96	500
Hexachloroethane	0/14	nd	nd	20	100
Isophorone	0/14	nd	nd	20	100
Nitrobenzene	0/14	nd	nd	20	100
N-Nitrosodimethylamine	0/14	nd	nd	96	500
N-Nitroso-di-n-propylamine	0/14	nd	nd	20	100
N-Nitrosodiphenylamine	0/14	nd	nd	20	100
Pentachlorophenol	1/14	23 J	23 J	200	1,000
Phenol	12/14	12 J	1,900	150	300

[a] Totals were calculated following rules described in Appendix B

Data qualifier: J - estimated concentration

na – neither SQS/SL nor CSL/ML is available

nd – not detected

Table 4-42. Concentrations of SVOCs detected in at least one sediment sample co-located with clam tissue samples compared to SQS and CSL

ANALYTE	UNIT	C1	C2-S1	C2-S2	C3-S1	C3-S2	C4	C5	C6	C7-S1	C7-S2	C8	C9	C10-S1	C10-S2	SQS	CSL
PAHs																	
2-Methylnaphthalene	mg/kg-OC	0.36 J	0.34	0.17 J	0.39 J	0.23 J	1.2	1.9	0.30 J	0.27 J	0.40 J	2.0	0.50 J	0.50	0.41	38	64
Acenaphthene	mg/kg-OC	0.30 J	0.82	0.10 J	0.15 J	0.28 J	0.19 J	13	0.37 J	0.39	0.59 J	**25**	0.48 J	0.46	0.36	16	57
Acenaphthylene	mg/kg-OC	0.85 J	1.7	0.12 J	1.1	0.68	3.4	3.8	0.43	1.0	0.79	3.6	0.77 J	0.44	0.43	66	66
Anthracene	mg/kg-OC	1.7	4.3	0.34 J	1.6	1.5	2.4	18	1.4	3.0	3.2	31	2.1	4.7	2.5	220	1,200
Benzo(a)anthracene	mg/kg-OC	3.4	9.9	0.72	4.7	4.0	10	50	3.3	8.4	13	**150**	7.5	12	7.0	110	270
Benzo(a)pyrene	mg/kg-OC	3.4	8.8	0.79	5.1	5.8	14	53	3.4	9.7	14	**230**	7.3	12	5.3	99	210
Benzo(b)fluoranthene	µg/kg dw	17	120	12	45	79	140	210	58	220	160	4,600	67	220	180	na	na
Benzo(g,h,i)perylene	mg/kg-OC	2.6	4.4	0.74	3.9	6.0	10	**34**	3.0	8.4	13	**180**	5.5	8.6	3.6	31	78
Benzo(k)fluoranthene	mg/kg-OC	16	130	8.4	40	61	140	180	47	150	110	3,500	45	150	140	na	na
Total benzofluoranthenes (calc'd)[a]	mg/kg-OC	7.0	14	1.9	9.1	11	20	120	8.5	24	35	**380**	20	23	14	230	450
Chrysene	mg/kg-OC	7.7	10	1.1	7.0	9.2	16	91	5.7	14	22	**170**	13	20	14	100	460
Dibenzo(a,h)anthracene	mg/kg-OC	0.51 J	1.2	0.15 J	0.75	1.4	1.9	8.8	0.60	1.7	2.6	**71**	1.4	2.3	0.88	12	33
Dibenzofuran	mg/kg-OC	0.28 J	0.93	0.15 J	0.18 J	0.25 J	0.32 J	6.6	0.39 J	0.34	0.60 J	4.1	0.50 J	0.41	0.34	15	58
Indeno(1,2,3-cd)pyrene	mg/kg-OC	2.6	5.4	0.72	3.8	4.9	10	**41**	3.1	7.7	13	**200**	5.5	8.0	3.7	34	88
Naphthalene	mg/kg-OC	0.81 J	0.48	0.43	0.56	0.40	1.9	4.1	0.54	0.46	0.54 J	2.1	0.73 J	0.39	0.26	99	170
Fluoranthene	mg/kg-OC	8.3	25	1.7	10	9.9	14	140	7.8	17	26	**260**	18	28	15	160	1,200
Fluorene	mg/kg-OC	0.49 J	3.0	0.13 J	0.25 J	0.47	0.37	10	0.44	0.51	0.77	9.0	0.70 J	0.86	0.84	23	79
Phenanthrene	mg/kg-OC	3.8	25	0.75	2.7	4.8	3.1	72	2.9	4.5	10	**100**	8.6	12	7.5	100	480
Pyrene	mg/kg-OC	8.1	23	2.2	12	9.9	19	120	7.0	20	23	250	15	27	12	1,000	1,400
Total HPAH (calc'd)[a]	mg/kg-OC	43 J	100	10 J	56	62	110	660	42	110	160	**1,900**	93	140	75	960	5,300
Total LPAH (calc'd)[a]	mg/kg-OC	8.1 J	36	1.9 J	6.3 J	8.1 J	11 J	120	6.0 J	9.9	16 J	180	13 J	19	12	370	780
Phthalates																	
Bis(2-ethylhexyl)phthalate	mg/kg-OC	6.4 J	0.66 J	1.9 J	1.3 J	4.4 J	6.4 J	13 J	4.4 J	15 J	21 J	**120**	4.3 J	6.1 J	4.4 J	47	78
Butyl benzyl phthalate	mg/kg-OC	4.3 U	1.1 U	1.9 U	2.2 U	3.8 U	7.1 U	3.0 J	0.56 J	6.4 U	6.4 U	**10**	3.6 U	6.1 U	2.2 U	4.9	64
Di-n-butyl phthalate	mg/kg-OC	1.5 J	1.1 U	1.9 U	2.2 U	3.8 U	7.1 U	9.1 J	1.6 U	6.4 U	6.4 U	4.7 U	1.6 J	6.1 U	17	220	1,700
Di-n-octyl phthalate	mg/kg-OC	4.3 U	1.1 U	1.9 U	2.2 U	3.8 U	7.1 U	6.3 U	1.6 U	2.1 J	4.4 J	7.6	3.6 U	6.1 U	1.3 J	58	4,500

ANALYTE	UNIT	C1	C2-S1	C2-S2	C3-S1	C3-S2	C4	C5	C6	C7-S1	C7-S2	C8	C9	C10-S1	C10-S2	SQS	CSL
Other SVOCs																	
4-Chloro-3-methylphenol	µg/kg dw	20 U	20 U	20 U	20 U	50 U	100 U	20 U	6.4 J	99 U	50 U	100 U	20 U	100 U	50 U	na	na
4-Methylphenol	µg/kg dw	8.7 J	62	160	20 U	50 U	100 U	20 U	20 U	99 U	50 U	100 U	24	150	29 J	670	670
Benzyl alcohol	µg/kg dw	20 U	20 U	20 U	20 U	50 U	100 U	20 U	23	99 U	50 U	100 U	20 U	100 U	50 U	57	73
Carbazole	µg/kg dw	20 U	66	20 U	4.3 J	50 U	82 J	21 J	5.0 J	70 J	17 J	140	4.1 J	2,100	59	na	na
Hexachlorobenzene	mg/kg-OC	0.21 U	0.054 U	0.092 U	0.10 U	0.076 U	0.31	0.31 U	0.080 U	0.064 U	0.13 U	0.052 U	0.14 J	0.080 U	0.057 J	0.38	2.3
Pentachlorophenol	µg/kg dw	200 U	200 U	200 U	200 U	500 U	1,000 U	23 J	200 U	990 U	500 U	1,000 U	200 U	1,000 U	500 U	360	690
Phenol	µg/kg dw	**600**	**450**	290	40 J	150 U	99 J	59	12 J	300 U	14 J	47 J	87	**1,900**	**1,400**	420	1,200

[a] Totals were calculated following rules described in Appendix B

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration

Bold indicates concentration or reporting limit above the SQS/SL

Bold underlined indicates concentration or reporting limit above the CSL/ML

SQS and CSL values are provided for comparative purposes in this data report; these standards have no relevance to bioaccumulation in clams

Dry weight concentrations for OC-normalized results are presented in Appendix A

na – neither SQS/SL nor CSL/ML is available

SVOCs were detected in all sediment samples collected with clam tissue samples and are described in more detail, as follows:

- A total of 29 SVOCs were detected in at least one sediment sample co-located with the clam tissue samples; the highest number of SVOCs were detected at location C10-S2 (25).
- At location C8, concentrations of acenaphthene, benzo(a)anthracene, chrysene, total benzofluoranthenes, fluoranthene, phenanthrene, and total HPAH exceeded their respective SQS. In addition, concentrations of benzo(a)pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene exceeded their respective CSLs.
- At location C5, concentrations of benzo(g,h,i)perylene and indeno(1,2,3-cd) pyrene exceeded their respective SQS.
- Four phthalates—bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, di-n-butyl phthalate, and di-n-octyl phthalate—were detected in the sediment samples. At location C8, the concentration of bis(2-ethylhexyl)phthalate exceeded the CSL and the concentration of butyl benzyl phthalate exceeded the SQS.
- Phenol concentrations at locations C1, C2-S1, C10-S1 and C10-S2 exceeded the SQS and phenol concentrations at locations C10-S1 and C10-S2 also exceeded the CSL.

4.2.4 PCBs and organochlorine pesticides

The results from the PCBs as Aroclors and organochlorine pesticide analyses of clam tissue and co-located sediment samples are presented in Sections 4.2.4.1 and 4.2.4.2.

4.2.4.1 Tissue

Table 4-43 presents a summary of the PCBs as Aroclors and organochlorine pesticides analyzed in clam tissue samples, including the number of detections, the range of detected concentrations, and the range of reporting limits. Results for all PCBs and organochlorine pesticides detected in at least one clam tissue sample are presented in Table 4-44. The results are presented in full in Appendix A, Table A-7.

Table 4-43. Summary of PCBs as Aroclors and organochlorine pesticide concentrations in clam tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
Aroclor 1016	0/14	nd	nd	10	10
Aroclor 1221	0/14	nd	nd	20	20
Aroclor 1232	0/14	nd	nd	10	10
Aroclor 1242	0/14	nd	nd	10	10
Aroclor 1248	3/14	64 J	190 J	10	10

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg ww)	Maximum Detected Concentration (µg/kg ww)	Minimum Reporting Limit (µg/kg ww)	Maximum Reporting Limit (µg/kg ww)
Aroclor 1254	14/14	24	390	na	na
Aroclor 1260	2/14	240	250	10	10
Total PCBs (calc'd)[a]	14/14	24	580 J	na	na
2,4'-DDD	9/14	2.0 J	4.8	1.0	4.4
2,4'-DDE	0/14	nd	nd	1.0	1.5
2,4'-DDT	12/14	2.1 J	21 J	3.2	3.5
4,4'-DDD	13/14	0.23 J	1.4	1.0	1.0
4,4'-DDE	9/14	0.70 J	3.5 J	1.0	1.0
4,4'-DDT	14/14	0.84 J	12	na	na
Total DDTs (calc'd)[a]	14/14	3.8 J	33 J	na	na
Aldrin	3/14	0.77 J	1.0 J	1.0	1.0
Dieldrin	4/14	3.8 J	5.0 J	1.0	24
alpha-BHC	1/14	0.35 J	0.35 J	1.0	1.0
alpha-Chlordane	0/14	nd	nd	1.0	1.0
alpha-Endosulfan	2/14	0.53 J	2.8	1.0	4.3
beta-BHC	10/14	0.41 J	1.9 J	1.0	1.1
beta-Endosulfan	4/14	3.8	4.8 J	1.0	1.2
delta-BHC	3/14	0.51 J	2.2 J	1.0	1.0
Endosulfan sulfate	0/14	nd	nd	1.0	1.0
Endrin	11/14	0.10 J	1.6 J	1.0	1.0
Endrin aldehyde	2/14	0.42 J	0.49 J	1.0	3.6
Endrin ketone	0/14	nd	nd	1.0	2.6
gamma-BHC	3/14	0.51 J	2.5 J	1.0	1.0
gamma-Chlordane	14/14	0.86 J	9.3	na	na
Heptachlor	0/14	nd	nd	1.0	1.0
Heptachlor epoxide	5/14	1.1 J	1.5 J	1.0	1.0
Methoxychlor	1/14	0.63 J	0.63 J	1.0	1.0
Mirex	0/14	nd	nd	1.0	1.0
Toxaphene	0/14	nd	nd	50	250

[a] Totals were calculated following rules described in Appendix B

Data qualifier: J - estimated concentration

na – not applicable

nd – not detected

Table 4-44. Concentrations of PCBs as Aroclors and organochlorine pesticides (µg/kg ww) detected in at least one clam tissue sample

ANALYTE	C1	C2-T1	C2-T2	C3-T1	C3-T2	C4	C5	C6	C7-T1	C7-T2	C8	C9	C10-T1	C10-T2
Aroclor 1248	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	64 J	75 J	190 J	10 U	10 U	10 U
Aroclor 1254	24	24	29	33	32	31	43	34	160	170	390	50	77	79
Aroclor 1260	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	240	250
Total PCBs (calc'd)[a]	24	24	29	33	32	31	43	34	220 J	250 J	580 J	50	320	330
2,4'-DDD	1.0 U	1.0 UJ	2.0 J	2.1 J	2.2 J	2.8 J	3.2 J	2.6 J	2.3 UJ	2.9 U	4.4 U	3.1 J	4.2	4.8
2,4'-DDT	2.1 J	2.8 J	2.7	2.1	2.8	3.3 J	2.9	3.2 J	7.1 J	6.9	21 J	3.0 J	3.2 U	3.5 U
4,4'-DDD	0.66 J	0.92 J	1.4	0.45 J	0.48 J	0.40 J	0.54 J	0.49 J	1.3 J	1.2	1.0 U	0.56 J	0.23 J	0.24 J
4,4'-DDE	1.0 U	1.0 UJ	1.6 J	1.3 J	1.1	0.70 J	0.86 J	0.84 J	3.5 J	2.4	1.0 U	1.0 J	1.0 U	1.0 U
4,4'-DDT	1.0 J	0.84 J	1.9	1.7	1.8	1.2 J	2.1	1.4	4.1 J	5.2	12	2.2	8.9	8.6 J
Total DDTs (calc'd)[a]	3.8 J	4.6 J	9.6 J	7.7 J	8.4 J	8.4 J	9.6 J	8.5 J	16 J	15.7	33 J	9.9 J	13.3 J	13.6 J
Aldrin	1.0 U	0.95 J	1.0 J	1.0 U	0.77 J	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Dieldrin	1.0 U	1.0 UJ	1.0 U	3.8 J	4.6 J	1.0 U	5.0 J	1.0 U	1.0 UJ	1.0 U	24 U	3.8	1.0 U	1.0 U
alpha-BHC	1.0 U	1.0 UJ	1.0 U	1.0 U	0.35 J	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
alpha-Endosulfan	1.0 U	1.0 UJ	0.53 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.8 UJ	2.8	4.3 U	1.0 U	1.0 U	1.0 U
beta-BHC	1.3 J	0.76 J	0.41 J	0.88 J	1.1 J	0.74 J	1.1 J	0.78 J	1.9 J	1.0 UJ	1.0 UJ	1.0 UJ	1.1 UJ	1.6 J
beta-Endosulfan	1.1 U	1.0 UJ	1.0 U	4.8 J	1.2 U	1.0 U	1.0 U	1.1 U	4.8 J	1.0 U	1.0 U	1.0 U	4.6 J	3.8
delta-BHC	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.51 J	0.98 J	2.2 J	1.0 U	1.0 U	1.0 U
Endrin	1.0 U	0.14 J	0.21 J	1.0 U	0.14 J	0.10 J	0.27	0.16 J	0.67 J	0.45 J	1.6 J	1.0 U	0.23 J	0.23 J
Endrin aldehyde	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.49 J	0.42 J	3.6 U	1.0 U	1.0 U	1.0 U
gamma-BHC	1.0 U	1.0 UJ	0.51 J	1.0 U	1.0 U	1.0 U	0.99 J	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	2.5 J	1.0 U
gamma-Chlordane	1.3 J	0.99 J	1.1 J	1.1 J	1.0	0.86 J	1.2	1.0	3.5 J	3.6 J	9.3	1.5 J	1.2 J	1.1 J
Heptachlor epoxide	1.0 U	1.0 UJ	1.0 U	1.1 J	1.0 U	1.0 U	1.5 J	1.2 J	1.0 UJ	1.0 U	1.5 J	1.5 J	1.0 U	1.0 U
Methoxychlor	1.0 U	1.0 UJ	1.0 U	1.0 U	0.63 J	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

[a] Totals were calculated following rules described in Appendix B

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown

PCBs and organochlorine pesticides were detected in all clam tissue samples and are described in more detail, as follows:

- Aroclor 1254 was detected at all locations with concentrations ranging from 24 µg/kg ww at locations C1 and C2-T2 to 390 µg/kg ww at location C8. Aroclor 1248 was detected in tissue samples from locations C7-T-1, C7-T-2, and C8. Aroclor 1260 was detected in tissue samples from locations C10-T1 and C10-T2. Total PCBs ranged from 24 µg/kg ww at locations C1 and C2-T1 to 580 µg/kg ww at location C8.
- Total DDTs were detected at all locations with concentrations ranging from 3.8 µg/kg ww at location C1 to 33 µg/kg ww at location C8
- Thirteen other pesticides were detected in at least one clam tissue sample, with gamma-chlordane measured at the highest concentration (9.3 µg/kg ww at location C8)

4.2.4.2 Sediment co-located with clam tissue samples

Table 4-45 presents a summary of the PCBs as Aroclors and organochlorine pesticides analyzed in sediment samples co-located with clam tissue samples, including the number of detections, the range of detected concentrations, and the range of reporting limits. Results for all PCBs and organochlorine pesticides detected in at least one sediment sample collected with the clam tissue samples are presented in Table 4-46, and compared to SQS/SL and CSL/ML. Concentrations in bold text are above the SQS or SL. Concentrations in bold underlined text are above the CSL or ML. Reporting limits that exceed the applicable SQS/SL and CSL/ML are discussed in Section 4.2.7. The results are presented in full in Appendix A, Table A-8.

Table 4-45. Summary of PCB as Aroclors and organochlorine pesticide concentrations in sediment samples co-located with clam tissue samples

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
Aroclor 1016	0/14	nd	nd	9.7	200
Aroclor 1221	0/14	nd	nd	20	400
Aroclor 1232	0/14	nd	nd	9.7	200
Aroclor 1242	0/14	nd	nd	9.7	200
Aroclor 1248	0/14	nd	nd	9.7	200
Aroclor 1254	10/14	14	3,300	10	200
Aroclor 1260	10/14	3.1 J	15,000	11	99
Total PCBs (calc'd)[a]	13/14	3.1 J	15,000	na	na
2,4'-DDD	1/14	1.6 J	1.6 J	0.97	25
2,4'-DDE	0/14	nd	nd	0.97	25

Analyte	Detection Frequency	Minimum Detected Concentration (µg/kg dw)	Maximum Detected Concentration (µg/kg dw)	Minimum Reporting Limit (µg/kg dw)	Maximum Reporting Limit (µg/kg dw)
2,4'-DDT	10/14	0.24 J	6.0	0.97	34
4,4'-DDD	10/14	0.30 J	5.8 J	0.98	6.9
4,4'-DDE	5/14	0.54 J	2.6	0.97	1.4
4,4'-DDT	11/14	0.48 J	20 J	9.9	25
Total DDTs (calc'd)[a]	13/14	0.72 J	470 J	na	na
Aldrin	2/14	0.39 J	0.81 J	0.97	6.8
Dieldrin	0/14	nd	nd	0.97	91
alpha-BHC	1/14	0.81 J	0.81 J	0.97	1.0
alpha-Chlordane	2/14	0.10 J	0.13 J	0.97	1.0
alpha-Endosulfan	8/14	0.18 J	71 J	0.97	1.5
beta-BHC	2/14	0.69 J	2.5	0.98	1.0
beta-Endosulfan	0/14	nd	nd	0.97	6.6
delta-BHC	2/14	0.42 J	11	0.97	1.0
Endosulfan sulfate	1/14	0.63 J	0.63 J	0.97	7.2
Endrin	2/14	0.99 J	4.6 J	0.97	3.5
Endrin aldehyde	4/14	0.28 J	41 J	0.97	53
Endrin ketone	1/14	110 J	110 J	0.97	59
gamma-BHC	2/14	1.8 J	6.7 J	0.97	9.9
gamma-Chlordane	10/14	0.20 J	130 J	1.0	96
Heptachlor	1/14	0.89 J	0.89 J	0.97	1.0
Heptachlor epoxide	0/14	nd	nd	0.62 UJ	1.9
Methoxychlor	3/14	0.34 J	0.96 J	0.98	18
Mirex	1/14	1.0 J	1.0 J	0.97	5.2
Toxaphene	0/14	nd	nd	49	4,300

[a] Totals were calculated following rules described in Appendix B

Data qualifier: J - estimated concentration

na – not applicable

nd – not detected

Table 4-46. Concentrations of PCBs as Aroclors and organochlorine pesticides detected in at least one sediment sample co-located with clam tissue samples compared to SQS/SL and CSL/ML

ANALYTE	UNIT	C1	C2-S1	C2-S2	C3-S1	C3-S2	C4	C5	C6	C7-S1	C7-S2	C8	C9	C10-S1	C10-S2	SQS/SL	CSL/ML
Aroclor 1254	µg/kg dw	10 U	28	50	24	11 U	69	25	28	1,000	180	3,300	14	100 U	200 U	na	na
Aroclor 1260	µg/kg dw	3.1 J	28	49	28 J	11 U	57 U	28	33	99 U	200 J	99 U	21	6,600	15,000	na	na
Total PCBs (calc'd)[a]	µg/kg dw	3.1 J	56	99	52 J	20 U	69	53	61	1,000	380 J	3,300	35	6,600	15,000	na	na
Total PCBs (calc'd)[a]	mg/kg-OC	0.66 J	3.1	9.3	5.6 J	1.5 U	4.9	**17**	4.9	**65**	**49 J**	**160**	6.3	**400**	**660**	12	65
2,4'-DDD	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	1.9 U	0.98 U	0.99 U	8.1 U	3.1 U	25 U	1.6 J	10 J	25 U	na	na
2,4'-DDT	µg/kg dw	0.24 J	2.2	3.3	1.9	1.8	4.0	2.0	2.1	25 U	11	36	1.3	12 U	25 U	na	na
4,4'-DDD	µg/kg dw	1.0 U	0.47 J	0.42 J	0.30 J	0.96 J	0.98 U	0.44 J	0.61 J	4.4 J	1.0	5.8 J	0.30 J	2.1 U	6.9 UJ	na	na
4,4'-DDE	µg/kg dw	1.0 U	0.95 J	0.98 U	1.1 J	2.6	1.6 J	0.98 U	0.54 J	0.99 U	1.0 U	1.4 U	0.97 U	1.0 U	0.98 UJ	na	na
4,4'-DDT	µg/kg dw	0.48 J	1.9	3.3	2.8	7.9	4.8	2.5	3.0	25 U	13	25 U	1.9	9.9 U	20 J	na	na
Total DDTs (calc'd) [a,b]	µg/kg dw	0.72 J	5.5 J	**7.0 J**	6.1 J	**13 J**	**10 J**	4.9 J	6.3 J	4.4	**25**	**36**	5.1 J	12 U	**20**	6.9	69
Aldrin	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	0.81 J	0.98 U	0.39 J	0.99 U	1.0 U	6.8 U	0.97 U	1.0 U	0.98 UJ	10	na
alpha-BHC	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	0.98 U	0.98 U	0.99 U	0.99 U	1.0 U	0.99 U	0.97 U	0.81 J	0.98 UJ	na	na
alpha-Chlordane	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	0.98 U	0.13 J	0.99 U	0.99 U	1.0 U	0.99 U	0.10 J	1.0 U	0.98 UJ	10	na
alpha-Endosulfan	µg/kg dw	1.0 U	0.24 J	0.63 J	0.26 J	1.0 U	0.98 U	0.33 J	0.29 J	27 J	1.0 U	71 J	0.18 J	1.0 U	1.5 UJ	na	na
beta-BHC	µg/kg dw	1.0 U	0.99 U	0.98 U	0.69 J	1.0 U	0.98 U	0.98 U	0.99 U	0.99 U	1.0 U	0.99 U	0.97 U	2.5	0.98 UJ	na	na
delta-BHC	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	0.98 U	0.98 U	0.99 U	0.42 J	1.0 U	11	0.97 U	1.0 U	0.98 UJ	na	na
Endosulfan sulfate	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	0.63 J	0.98 U	0.98 U	0.99 U	0.99 U	1.0 U	7.2 U	0.97 U	1.0 U	0.98 UJ	na	na
Endrin	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	0.98 U	0.98 U	0.99 U	4.6 J	0.99 J	3.5 U	0.97 U	1.0 U	2.0 UJ	na	na
Endrin aldehyde	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	0.28 J	0.98 U	0.98 U	0.99 U	9.3 J	2.4 J	41 J	0.97 U	25 U	53 UJ	na	na
Endrin ketone	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	0.98 U	0.98 U	0.99 U	1.3 U	1.0 U	7.9 U	0.97 U	59 UJ	110 J	na	na
gamma-BHC [b]	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	0.98 U	0.98 U	0.99 U	1.8 J	1.0 U	6.7 J	0.97 U	9.9 U	0.98 UJ	10	na
gamma-Chlordane	µg/kg dw	0.20 J	1.4 J	1.5 J	0.99 J	1.0 U	2.3 U	1.1 J	1.1 J	**35 J**	5.5 J	**130 J**	0.47 J	49 UJ	96 UJ	10	na
Heptachlor [b]	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	0.98 U	0.98 U	0.99 U	0.99 U	1.0 U	0.99 U	0.97 U	1.0 U	0.89 J	10	na
Methoxychlor	µg/kg dw	0.96 J	0.50 J	0.98 U	0.34 J	1.7 U	0.98 U	0.98 U	0.99 U	1.1 U	1.0 U	2.5 U	0.97 U	18 U	4.0 UJ	na	na
Mirex	µg/kg dw	1.0 U	0.99 U	0.98 U	0.97 U	1.0 U	1.4 U	1.4 U	0.99 U	0.99 U	1.0 U	1.9 U	0.97 U	5.2 U	1.0 J	na	na

[a] Totals were calculated following rules described in Appendix B

[b] No SQS or CSL is available; concentration in sediment is compared to SL and ML

Data qualifiers: U - not detected at reporting limit shown; J - estimated concentration; UJ - not detected at estimated reporting limit shown

Bold indicates concentration or reporting limit above the SQS/SL; **Bold underlined** indicates concentration or reporting limit above the CSL/ML

SQS/SL and CSL/ML values are provided for comparative purposes in this data report; these standards have no relevance to bioaccumulation in clams

Dry weight concentrations for OC-normalized results are presented in Appendix A

na – neither SQS/SL nor CSL/ML is available

PCBs and organochlorine pesticides were detected at most locations and are described in more detail, as follows:

- Aroclor 1254 was detected at all locations except C1, C3-S2, C10-S1, and C10-S2. Aroclor 1254 concentrations ranged from 14 µg/kg dw at location C9 to 3,300 µg/kg dw at location C8. Aroclor 1260 was detected at all locations except C3-S2, C4, C7-S1, and C8. Aroclor 1260 concentrations ranged from 3.1 µg/kg dw at location C1 to 15,000 µg/kg dw at location C10-S2. Total PCB concentrations exceeded the SQS at locations C5 and C7-S2. In addition, total PCB concentrations exceeded both the SQS and the CSL at locations C7-S1, C8, C10-S1, and C10-S2.
- Total DDT concentrations exceeded the SL at locations C2-S2, C3-S2, C4, C7-S2, and C-8. In addition, the total DDT RL for C10-S1 exceeded the SL.
- gamma-Chlordane concentrations exceeded the SL criterion for chlordane at locations C7-S1 and C8

4.2.5 Lipids and moisture in clam tissue samples

Table 4-47 presents percent lipid and percent moisture measured in clam tissue samples collected in the LDW and at the two background areas. Lipids in clam tissue samples ranged from 0.20% ww to 0.88% ww and moisture ranged from 77.5% ww to 87.2% ww.

4.2.6 Grain size, TOC, and total solids in sediment samples co-located with clam tissue samples

Table 4-48 presents the results of grain size, TOC, and total solids analyses of sediment samples collected with clam tissue samples. Total solids measurements from the two background areas are included in the table (TOC and grain size were not analyzed in background sediments). Sediment data are presented in full in Appendix A, Table A-8.

Table 4-47. Percent lipid and moisture in clam tissue samples

ANALYTE	UNIT	C1	C2-T1	C2-T2	C3-T1	C3-T2	C4	C5	C6	C7-T1	C7-T2	C8	C9	C10-T1	C10-T2
Lipid	% ww	0.65	0.60	0.66	0.64	0.76	0.75	0.79	0.81	0.78	0.83	0.80	0.79	0.55	0.57
		BI-C-T1	BI-C-T2	BI-C-T3	BI-C-T4	BI-C-T5	BI-C-T6	SP-C-T1	SP-C-T2	SP-C-T3	SP-C-T4	SP-C-T5	SP-C-T6		
		0.61	0.64	0.66	0.88	0.83	0.73	0.40	0.20	0.21	0.26	0.26	0.23		
Moisure[a]	% ww	C1	C2-T1	C2-T2	C3-T1	C3-T2	C4	C5	C6	C7-T1	C7-T2	C8	C9	C10-T1	C10-T2
		86.3	86.9[b]	84.3[b]	84.9	82.7	86.4	84.4	84.7	85.1	84.7	83.8	84.4	86.3	87.2
		BI-C-T1	BI-C-T2	BI-C-T3	BI-C-T4	BI-C-T5	BI-C-T6	SP-C-T1	SP-C-T2	SP-C-T3	SP-C-T4	SP-C-T5	SP-C-T6		
		80.8	81.4	82.7	79.0	80.3	81.2	84.8	79.1	77.5	77.8	78.0	78.1		

[a] Moisture is calculated as 100% - total solids

[b] Result shown is average of one or more laboratory replicate analyses

Table 4-48. Grain size, TOC, and total solids, (% dw) in sediment samples co-located with clam tissue samples

ANALYTE	C1	C2-S1	C2-S2	C3-S1	C3-S2	C4	C5	C6	C7-S1	C7-S2	C8	C9	C10-S1	C10-S2
Rocks (total calc'd)	1.64	1.32	3.05	18.0	4.17	16.2	1.72	2.18	48.0	71.5	37.4	4.32	19.7	24.0
Sand (total calc'd)	76.0	53.6	72.7	71.5	78.0	75.5	93.5	80.2	36.4	27.2	41.4	88.1	62.9	58.8
Silt (total calc'd)	19.3	36.3	20.7	10.8	15.8	7.82	3.64	15.6	5.59	6.04	21.1	5.07	14.5	10.9
Clay (total calc'd)	4.00	9.74	3.90	2.16	2.17	3.24	1.82	3.18	1.79	1.37	3.24	1.87	4.40	3.34
Fines (percent silt+clay)	23.3	46.0	24.6	12.9	18.0	11.06	5.46	18.8	7.38	7.41	24.3	6.94	18.9	14.2
TOC	0.47	1.82	1.06	0.93	1.31	1.40	0.32	1.24	1.55	0.78	2.11	0.56	1.63	2.27
Total solids	74.2	55.9	70.4	72.2	75.2	67.5	73.8	70.2	78.0	78.3	60.3	75.7	50.4	51.5
	BI-C-S1	BI-C-S2	BI-C-S3	BI-C-S4	BI-C-S5	BI-C-S6	SP-C-S1	SP-C-S2	SP-C-S3	SP-C-S4	SP-C-S5	SP-C-S6		
	74.6	72.4	74.1	73.2	73.8	75.0	84.0	77.2	79.5	75.9	76.0	80.1		

Grain size, TOC, and total solids analyses of all sediment samples collected with clam tissue samples are described in more detail, as follows:

- Sediments at all locations except C1, C2-S1, C2-S2, and C8 were coarse with percent fines ranging from 5.5% dw to 18.78% dw. Locations C1, C2-S1, C2-S2, and C8 had medium grain-sized sediments with percent fines ranging from 23.3% to 46.0% dw
- TOC in the sediment samples ranged from 0.32% dw at location C5 to 2.27% dw at location C10-S2
- Total solids in the LDW sediment samples ranged from 50.4% ww at location C10-S1 to 78.3% ww at location C7-S2. At the two background areas, total solids ranged from 72.4% ww to 84.0% ww.

4.2.7 Comparison of nondetected results to analytical concentration goals

The RLs for clam tissue and co-located sediment samples were compared to their respective risk-based ACGs that were presented in Appendix C of the QAPP (Windward 2004b). All clam tissue RLs were lower than the applicable ACGs except for the chemicals summarized in Table 4-49. Tissue RLs for 23 chemicals (275 individual results) were above the corresponding ACGs. Tissue MDLs were above the ACGs with almost the same frequency as RLs – 219 results for 19 chemicals (Table 4-49). The magnitude by which the RLs and MDLs were above the ACGs was most pronounced for carcinogenic chemicals, such as benzidine and 3,3'-dichlorobenzidine, with low ACGs that are prone to photochemical degradation and are therefore very difficult to quantitate analytically (Grindstaff 2005). All of the analytes listed in Table 4-49 were identified in the QAPP (Windward 2004b) as being likely to have non-detected results above the ACG for clam tissue except for alpha-BHC, beta-BHC, carbazole, and hexachlorobutadiene.

Table 4-49. Number of RLs above risk-based ACGs in clam tissue samples

Chemical	Number of Detected Results	Range of Detected Results (µg/kg ww)	Number of Non-detect Results	Range of RLs (µg/kg ww)	Number of RLs > ACGs	Range of MDLs (µg/kg ww)	Number of MDLs > ACGs	Human Health ACG (µg/kg ww)
2,4-Dinitrophenol	0	na	14	770-800	14	23-23	0	170
3,3'-Dichlorobenzidine	0	na	14	2,000-2,000	14	780-780	14	2.3
Aldrin	3	0.77-1.0	11	1.0-1.0	11	0.20-1.0	11	0.059
alpha-BHC	1	0.35	13	1.0-1.0	13	0.16-1.0	8	0.17
Aniline	0	na	14	770-800	14	230-230	14	180
Aroclor-1221	0	na	14	20-20	14	3.1-3.1	14	0.51
Aroclor-1232	0	na	14	10-10	14	2.0-2.0	14	0.51
Aroclor-1242	0	na	14	10-10	14	3.5-3.5	14	0.51
Aroclor-1248	3	64-190	11	10-10	11	0.76-0.76	11	0.51
Aroclor-1260	2	240-250	12	10-10	12	4.7-4.7	12	0.51
Benzidine	0	na	14	5,000-5,000	14	5,000-5,000	14	0.0047
beta-BHC	10	0.41-1.9	4	1.0-1.1	4	0.21-1.1	3	0.59
bis(2-chloroethyl)ether	0	na	14	39-40	14	8.7-8.7	14	0.94
bis(2-ethylhexyl)phthalate	10	56-220	4	490-500	4	53-53	0	71
Carbazole	0	na	14	200-200	14	33-33	0	51
Dieldrin	4	3.8-5.0	10	1.0-24	10	0.11-24	10	0.065
Heptachlor	0	na	14	1.0-1.0	14	0.45-0.74	14	0.23
Heptachlor epoxide	5	1.1-1.5	9	1.0-1.0	9	0.15-1.0	9	0.11
Hexachlorobenzene	9	0.38-1.0	5	1.0-1.0	5	0.34-1.0	1	0.65
Hexachlorobutadiene	0	na	14	39-40	14	8.5-8.5	0	13
N-Nitrosodimethylamine	0	na	14	39-40	14	10-10	14	0.021
Pentachlorophenol	0	na	14	390-400	14	31-31	14	8.3
Toxaphene	0	na	14	50-250	14	22-250	14	0.94

[a] An ACG range was calculated for clam tissue sample analyses using two assumed human consumption rates. The analysis presented here is based on the lower ACG, which was derived using an overall human seafood consumption rate that was not specifically related to a single tissue type. See Appendix C in the QAPP (Windward 2004b).

RLs and MDLs for the sediment samples co-located with the clam tissue samples were compared to risk-based sediment ACGs. These ACGs are presented in Appendix C of the QAPP (Windward 2004b). RLs for 16 chemicals (158 individual results) were above the corresponding ACGs. MDLs were above the ACGs with almost the same frequency as RLs – 111 results for 15 chemicals (Table 4-50). Seven (aldrin and all Aroclors except Aroclor 1016) of the sixteen chemicals listed in Table 4-50 whose RLs were above ACGs were identified in the QAPP (Windward 2004b) as being likely to have non-detected results above the ACG for sediment associated with clam tissue.

RLs and MDLs were also compared to SQS/SL and CSL/ML. The RLs for sediment samples co-located with the clam tissue samples were lower than the applicable SQS or SL, except for the results summarized in Table 4-50. RLs for 75 results reported as undetected for 11 different chemicals were above the SQS or SL. Fifty-three of those results were also above the CSL or ML. Compared to RLs, the number of chemicals with MDLs above the SQS/SL or CSL/ML was lower, and the number of results with MDLs above the SQS/SL or CSL/ML was reduced by approximately two thirds (Table 4-50). An additional seven sediment samples (C2, C3-1, C3-2, C4, C5, C6, and C9) will be analyzed by GC/MS-SIM to achieve lower RLs. These results will be presented in an addendum to this data report.

4.3 DATA VALIDATION RESULTS

Independent data validation of all results was conducted by Laboratory Data Consultants Inc. (LDC). The complete data validation reports for both the tissue and sediment data are provided in Appendix C. The following sections provide a summary of the results of the validation.

4.3.1 Tissue

4.3.1.1 Overall data quality

The tissue samples were analyzed by Columbia in ten sample delivery groups (SDGs). LDC conducted a full validation on two SDGs (K2406232 and K2407455). Brooks Rand analyzed three SDGs for inorganic arsenic. A subset of one of the Brooks Rand SDGs was submitted for full validation (04BR710). All sample results that were not selected for full validation underwent a summary validation. Table 4-51 provides a summary of the number of samples in each SDG as well as the analyses performed and the level of data validation.

Table 4-50. Number of reporting limits (RLs) and method detection limits (MDLs) above the SQS/SL, CSL/ML, and risk-based ACGs in sediment samples co-located with clam tissue samples

Chemical	Detection Frequency	Range of Detected Concentrations (µg/kg dw)	Range of RLs (µg/kg dw)	# of RLs above the SQS/SL	# of RLs above the CSL/ML	# of RLs above the ACG[a]	Range of MDLs (µg/kg dw)	# of MDLs above the SQS/SL	# of MDLs above the CSL/ML	# of MDLs above the ACG[a]
1,2,4-Trichlorobenzene	0/14	na	20-100	12	10	na	4.0-30	5	1	na
1,2-Dichlorobenzene	0/14	na	20-100	7	7	0	3.5-26	0	0	0
1,4-Dichlorobenzene	0/14	na	20-100	7	0	4	5.1-38	0	0	0
2,4-Dimethylphenol	0/14	na	96-500	14	14	na	15-110	7	7	na
2-Methylphenol	0/14	na	20-100	4	4	0	9.0-68	1	1	0
4,4'-DDT	11/14	0.48J-20J	9.9-25	na	na	3	3.0-9.0	na	na	3
Aldrin	2/14	0.39J-0.81J	0.97-6.8	0	0	12	0.33-6.8	0	0	12
Aroclor-1016	0/14	na	9.7-200	na	na	14	2.3-70	na	na	4
Aroclor-1221	0/14	na	20-400	na	na	14	2.3-70	na	na	14
Aroclor-1232	0/14	na	9.7-200	na	na	14	2.3-70	na	na	14
Aroclor-1242	0/14	na	9.7-200	na	na	14	2.3-70	na	na	14
Aroclor-1248	0/14	na	9.7-200	na	na	14	2.3-70	na	na	14
Aroclor-1254	10/14	14-3,300	10-200	na	na	4	2.3-70	na	na	4
Aroclor-1260	10/14	3.1J-15,000	11-99	na	na	4	2.3-70	na	na	4
Benzoic acid	0/14	na	390-2,000	7	7	na	260-2,000	5	5	na
Benzyl alcohol	1/14	23	20-100	4	4	na	9.8-74	2	1	na
beta-BHC	2/14	0.69J-2.5	0.97-1.0	na	na	12	0.30-0.99	na	na	2
Butyl benzyl phthalate	3/14	7.0J-220	20-100	4	0	0	4.0-30	0	0	0
Dieldrin	0/14	na	0.97-91	2	0	14	0.11-91	2	0	14
Heptachlor	1/14	0.89J-0.89J	0.97-1.0	0	0	13	0.13-1.0	0	0	5
Hexachlorobutadiene	0/14	na	20-100	7	3	7	3.7-28	0	0	2
gamma-BHC	2/14	1.8J-6.7J	0.97-9.9	0	0	12	0.13-9.9	0	0	2
gamma-Chlordane	10/14	0.20J-130J	1.0-96	2	0	3	0.82-96	0	0	3
Pentachlorophenol	1/14	23J	200-1,000	7	4	na	23-170	0	0	na
Total				**75**	**53**	**158**		**22**	**15**	**111**

[a] The sediment ACGs used for comparison were derived from an overall seafood consumption rate not specifically related to clams or shellfish

Table 4-51. Summary of the number of tissue samples analyzed in each SDG

SDG	Lab	SVOC (8270C-SIM)	Pesticides (8081A)	PCBs (8082)	Metals and Mercury (SW846)	Inorganic Arsenic (1632)	Butyltins (Krone)	Level of Validation	Sample Location
K2406232	Columbia	14	7	7	7	na	7	full	ITBT
K2406297	Columbia	6	3	3	3	na	3	summary	STBT
K2406517	Columbia	14	14	14	14	na	28	summary	LDW-clam
K2406581	Columbia	2	1	1	1	na	1	summary	ITBT
K2406932	Columbia	4	2	2	2	na	2	summary	ITBT
K2407216	Columbia	5	2	2	2	na	2	summary	ITBT
K2407452	Columbia	1	1	1	1	na	1	summary	ITBT
K2407596	Columbia	4	4	4	4	na	4	summary	ITBT
K2407455	Columbia[a]	na	na	na	10[b]	na	na	summary	reference-clam
K2407455	Columbia[a]	na	na	na	2[b]	na	na	full	reference-clam
04BR710	Brooks Rand[a]	na	na	na	na	6	na	summary	LDW-clam
04BR710	Brooks Rand[a]	na	na	na	na	2	na	full	LDW-clam
04BR739	Brooks Rand	na	na	na	na	12	na	summary	reference-clam

ITBT – LDW intertidal benthic invertebrate tissue

STBT – LDW subtidal benthic invertebrate tissue

[a] Only a subset of the SDG was submitted for full validation

[b] Only arsenic was analyzed

na – not analyzed

Based on the information reviewed, the overall data quality was considered acceptable as qualified. The complete data validation report is presented in Appendix C. The results of the validation are summarized below by analyte group.

4.3.1.2 Sample Transport and Holding Times

All tissue samples were analyzed within the maximum holding times. The review of the COC forms and cooler temperatures identified one cooler that was reported to have arrived at the laboratory at 11° C. The temperature reflected air temperature in the cooler. The laboratory reported that samples appeared to be cooler than the recorded temperature and were immediately frozen. Because of the uncertainty associated with the measurement of the air temperature and the immediate freezing of the samples, no validation qualifiers were assigned.

4.3.1.3 Metals (including mercury and inorganic arsenic)

Calibration

The initial calibration was performed and the frequency and analysis criteria of the initial calibration verification and continuing calibration verification were met.

Blanks

Method blanks were reviewed. Cobalt and nickel were detected in two blanks. No data qualification resulted.

Matrix Spike

There was insufficient benthic invertebrate tissue sample available for matrix spike (MS) analysis in seven SDGs. When there was sufficient sample, the results were within QC limits.

The MS and matrix spike duplicate (MSD) results for the inorganic arsenic results associated with SDG 04BR739 (background clam samples) were above the QC limits for two samples. Therefore, the sample results associated with these results were flagged as estimated and potentially biased high (J+). The MS results ranged from 131-135% recovery compared to the QC limits of 75-125% recovery.

Duplicate Sample Analyses

Laboratory duplicate results were reviewed and results were within QC limits.

Laboratory Control Samples

The percent recoveries and relative percent differences (RPD) were within QC limits, except for silver in the LCS associated with three SDGs. Because silver was detected in all associated samples, the data were qualified as estimated (J qualifier).

ICP Serial Dilution

The ICP serial dilution analysis criteria were met with the following exceptions. Three benthic invertebrate tissue samples had dilutions with percent differences greater than 10%. One sample was qualified for cadmium, cobalt, copper, and silver. A second sample was qualified for cobalt, copper, nickel, and silver. The third sample was qualified for cadmium and nickel. In total, 22 benthic tissue samples were associated with these dilutions and were J qualified based on variability in the dilution samples. In addition, one clam tissue sample was qualified because of variability associated with arsenic in the diluted sample. Fourteen clam tissue samples were associated with the dilutions and were J qualified as a result.

Sample Result Verification

All sample result verifications met validation criteria.

4.3.1.4 Butyltins

Calibration

Initial calibration was performed as required by the method. Calibration verification was performed and all aspects of the calibration were within QC limits.

Blanks

No butyltin compounds were detected in the method blanks.

Matrix Spike

There was insufficient benthic invertebrate tissue sample to run MS/MSD samples for seven SDGs. The percent recoveries and RPD were not within QC limits in the MS/MSD run with SDG K2406517. However, because the sample concentration was above the spiked concentration, no data were qualified.

Duplicate Sample Analyses

Laboratory duplicate results were reviewed and results were within QC limits.

Standard Reference Materials and Laboratory Control Samples

LCS and SRM results were within QC limits.

Compound Quantification

The results for di-n-butyltin in three samples exceeded the 40% RPD allowed between the two analytical columns. These results were qualified as estimated (J qualified).

4.3.1.5 SVOCs (including PAHs)

Calibration

The initial calibration was conducted correctly. All response factors and system performance check compounds were adequate. Continuing calibration was conducted at the required frequencies. The only compounds with percent differences of the second source calibration standard greater than 25% (National Functional Guidelines criteria) were hexachlorocyclopentadiene, 4-nitrophenol, and 2-methyl-4,6-dinitrophenol. The results for these compounds in SDG K2106232were qualified as estimated (J qualifier).

Blanks

Five method blanks were found to contain SVOCs. One phenol concentration for LDW-B8b-T was initially reported as 89 µg/kg and was modified to 500U µg/kg as a result of the method blank result. The naphthalene concentrations in all 14 tissue samples in SDG K2406517 were qualified because of the presence of naphthalene in the method blank.

Matrix Spike

The MS/MSD results were reviewed. The result for 4-chloro-3-methylphenol was above the QC limits, resulting in the qualification (J qualifier) for all detected results for this compound.

Duplicate Sample Analyses

Laboratory duplicate results were reviewed and results were within QC limits.

SRM and Laboratory Control Samples

SRM results for PAHs were within QC limits.

LCS and laboratory control sample duplicates (LCSD) results were reviewed. Validation qualifiers (J) were assigned to results for the following analytes because of

LCS recoveries that were below the QC limits: aniline, 2,4-dimethylphenol, benzidine, benzoic acid,2,6-dinitrotoluene, carbazole, butylbenzylphthalate, bis(2-ethylhexyl) phthalate.

Zero percent recovery of benzidine in the LCS resulted in the qualification of non-detected results for benzidine as rejected in the SVOC analyses for two SDGs (K2407452 and K2407596).

Compound Quantification

One sample result for 4-methyl phenol was qualified because the sample result exceeded the calibration range (LDW-B9a-T).

4.3.1.6 PCBs and pesticides

Calibration

Initial and continuing calibrations were conducted as required by the methods. The percent relative standard deviations (RSDs) were less than or equal to 20% for all compounds and retention times of all compounds were within QC limits.

Blanks

No PCBs were detected in the PCB method blanks. One pesticide method blank was found to contain methoxychlor at a concentration of 0.81 µg/kg. No data qualification resulted.

Matrix Spike

The percent recoveries and RPDs were within QC limits for all PCB analyses. For pesticides, the percent recoveries and RPDs were within QC limits, except for the MS/MSD associated with SDG K2406517. This MS/MSD had a percent recovery of endrin aldehyde that was less than QC limits. Therefore, all results for endrin aldehyde were J qualified in this SDG.

Duplicate Sample Analyses

Laboratory duplicate results were reviewed and results were within QC limits.

SRM and Laboratory Control Samples

The LCS results for the PCB analyses were within QC limits for all analyses. For pesticides, the laboratory control samples were within QC limits for all analyses. The SRM results were within QC limits except for three compounds, beta-BHC, delta-BHC and 2,4'-DDD, which resulted in J qualifiers for these compounds in three SDGs. The result for beta-BHC was lower than the certified range and the results for delta-BHC and 2,4'-DDD were higher than the certified range.

Compound Quantification

All PCB compound identification and quantification were within validation criteria. The results for Aroclor 1248 in three samples were greater than 40% RPD between the two analytical columns. These results were qualified as estimated (J qualified).

Aroclor standards were run as interference check samples, and based on this analysis, all detected pesticides were JN qualified in SDG K240632 because of potential interference from PCBs. Target compound identification data were not reviewed for the SDGs submitted for summary validation.

Thirty samples contained detected pesticides for which the results for the two analytical columns were greater than 40% RPD. Therefore, the results associated with RPDs greater then 40% were J qualified.

4.3.2 Sediment

4.3.2.1 Overall data quality

The sediment samples were analyzed by Columbia in 11 SDGs (Table 4-52). LDC conducted a full validation on two SDGs (K2406170 and K2407471). All sample results that were not selected for full validation underwent summary validation.

Based on the information reviewed, the overall data quality was considered acceptable as qualified. The complete data validation report is presented in Appendix C. The results of the validation are summarized below by analyte group.

Table 4-52. Summary of the number of sediment samples analyzed in each SDG

SDG	SVOC (8270C-SIM)	Pesticides (8081A)	PCBs (8082)	Metals and Mercury (SW846)	Butyltins (Krone)	Level of Validation	Sample Locations
K2406516	14	19	14	14	14	summary	LDW-clam
K2406170	5	5	5	5	5	full	ITBS
K2406226	2	2	2	2	3	summary	STBS
K2406296	3	3	3	3	3	summary	STBS
K2406519	2	2	2	2	2	summary	ITBS
K2406580	1	2	1	1	1	summary	ITBS
K2407012	2	4	3	2	2	summary	ITBS
K2407473	1	1	1	1	1	summary	ITBS
K2407595	4	4	4	4	4	summary	STBS
K2407469	na	na	na	12[a]	na	summary	reference-clam
K2407471	na	na	na	2[a, b]	na	full	reference

ITBS – LDW benthic invertebrate intertidal co-located sediment

STBS – LDW benthic invertebrate subtidal co-located sediment

[a] Only arsenic was analyzed

[b] These samples were reference sediment. These data will be presented in the fish and crab data report.

na - not analyzed

4.3.2.2 Sample transport and holding times

All sediment samples were analyzed within the maximum holding times. The review of the COC forms and cooler temperatures identified one cooler that was reported to have arrived at the laboratory at 11° C. The temperature reflected air temperature in

the cooler. The laboratory reported that samples appeared to be cooler than the recorded temperature and were immediately frozen. Because of the uncertainty associated with the measurement of the air temperature and the immediate freezing of the samples, no validation qualifiers were assigned.

4.3.2.3 Metals

Calibration

The initial calibration was performed and the frequency and analysis criteria of the initial calibration verification and continuing calibration verification were met.

Blanks

Method blanks were reviewed. Lead, silver, thallium, molybdenum, and arsenic were detected in four blanks. Sample concentrations were compared to the maximum blank concentrations. Sample concentrations were either not detected or greater than five times the blank concentrations. The only exceptions were that results for thallium and silver were qualified as not detected with elevated reporting limits in one sample (LDW-B1a-S).

Matrix Spike

MS/MSD results were reviewed and results associated with five MS samples were outside of QC limits. Recoveries of antimony and zinc were less than the criteria. In SDG2406516, the result for zinc (%R = -9%) resulted in rejection of non-detected results and qualification of estimated with negative bias for the detected results (J- qualifier). In SDG2407012, the mercury percent recovery was above the QC limits, resulting in qualification of estimated with positive bias (J+ qualifier) for detected results.

The MS/MSD results for inorganic arsenic were above the QC limits for two samples. Therefore, the sample results associated with these QC samples were flagged as estimated and potentially biased high (J+). MS recovery ranged from 131-135% compared to the QC limits of 75-125% recovery.

Duplicate Sample Analyses

Laboratory duplicate sample analyses were reviewed and results were within QC limits except for two duplicate results with RPD values above 30%. In the first sample, lead, molybdenum, and zinc results were J qualified for 14 clam sediment samples in SDG K2406516. In the second sample, arsenic, molybdenum, and silver results were J qualified for five benthic sediment samples in SDGs K2407473 and K2407595.

Laboratory Control Samples

The percent recoveries and RPDs were within QC limits.

ICP Serial Dilution

The ICP serial dilution analysis criteria were met for all metals except arsenic and lead. Percent difference values greater than 10% were reported for arsenic in three dilutions associated with 20 sediment samples. A percent difference value greater than 10% was

reported for one dilution associated with 13 sediment samples. The results for arsenic and lead in these samples were J qualified as a result.

Sample Result Verification

All sample result verifications met validation criteria.

4.3.2.4 Butyltins

Calibration

Initial calibration was performed as required by the method. Calibration verification was performed and all aspects of the calibration were within QC limits.

Blanks

No butyltin compounds were detected in the method blanks.

Matrix Spike

The results of the MS/MSD analysis were within QC limits except for the results for monobutyltin in MS/MSD samples associated with three SDGs. The recoveries for monobutyltin in three MS samples were less than the QC limits. Therefore, the results for this compound were qualified as estimated in the associated SDGs.

Duplicate Sample Analyses

Laboratory duplicate results were reviewed and results were within QC limits.

SRM and Laboratory Control Samples

LCS and SRM results were within QC limits.

Compound Quantification

All compound quantification criteria were within validation criteria.

4.3.2.5 SVOCs including PAHs

Calibration

The initial calibration was conducted correctly. All response factors and system performance check compounds were adequate. Continuing calibration was conducted at the required frequencies. The only compound with a percent difference of the second source calibration standard greater than 25% was hexachlorocyclopentadiene; results for this chemical were qualified as estimated (J qualifier).

Blanks

Two method blanks contained phenol and bis(2-ethylhexyl)phthalate. Sample results for 10 samples were qualified based on phenol and bis(2-ethylhexyl)phthalate concentrations that were less than 10 times the blank concentrations. These results were qualified as not detected with elevated reporting limits.

Five of the PAH method blanks were found to contain naphthalene and 2-methyl naphthalene. Detected naphthalene concentrations in four samples (LDW-B10b-S,

LDW-B7a-S, LDW-B10a-S, LDW-B1b-S) were qualified as undetected because the sample concentration was less than 10 times the blank concentration.

Matrix Spike

The MS/MSD results were reviewed. The percent recovery for 1,4-dichlorobenzene was above the QC limits, resulting in the qualification (J qualifier) for all detected results for this compound in SDG K2407595.

The MS/MSD results for SDG K2407473 included two PAHs that had percent recoveries that were greater than QC limits, and the MS/MSD results for SDG K2407595 included twenty PAHs that had percent recoveries that were greater than QC limits. The MS/MSD results for SDG K2407595 included three PAHs that had percent recoveries that were greater than QC limits. All of the results for these compounds in the respective SDGs were qualified as estimated (J qualified).

Duplicate Sample Analyses

Laboratory duplicate results were reviewed and results were within QC limits.

SRM and Laboratory Control samples

SRM results for PAHs were within QC limits.

LCS and LCSD results were reviewed. Validation qualifiers (J) were assigned to results for the following analytes because of LCS recoveries that were below the QC limits: aniline, 4-chloroaniline, 2,4-dimethylphenol, benzidine, benzoic acid, and hexachlorocyclopentadiene.

Zero percent recovery of benzidine in the LCS resulted in the qualification of detected concentrations of this compound as estimated (J qualified) and the non-detected results for benzidine as rejected in all sediment samples. This compound is known to have poor recoveries when analyzed by method EPA 8270C.

Compound Quantification

All compound identifications and quantification criteria were within the QC limits.

4.3.2.6 PCBs and pesticides

Calibration

Initial and continuing calibrations were conducted as required by the methods. The percent RSDs were less than or equal to 20% for all compounds and retention times of all compounds were within QC limits.

Blanks

No PCBs were detected in the PCB method blanks. No organochlorine pesticides were found in the method blanks.

Matrix Spike

The percent recoveries and RPDs were within QC limits for all PCB analyses. For pesticides, the percent recoveries and RPDs were within QC limits except for the

MS/MSD associated with SDG K2406170. Percent recoveries of seven pesticides associated with this MSD sample were less than QC limits. Therefore, all results for these pesticides were J qualified in this SDG.

Duplicate Sample Analyses

Laboratory duplicate results were reviewed and results were within QC limits.

SRM and Laboratory Control Samples

The LCS results for the PCB analyses were within QC limits for all analyses. For pesticides, the laboratory control samples results for two SDGs (K2407473 and K2407595) resulted in estimated qualifiers for endrin aldehyde. The SRM results were within QC limits except for alpha-BHC, gamma-chlordane, and 2,4'-DDD, which were J-qualified in nine SDGs.

Compound Quantification

All PCB compound identification and quantification were within validation criteria.

5.0 References

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Oversize Figures

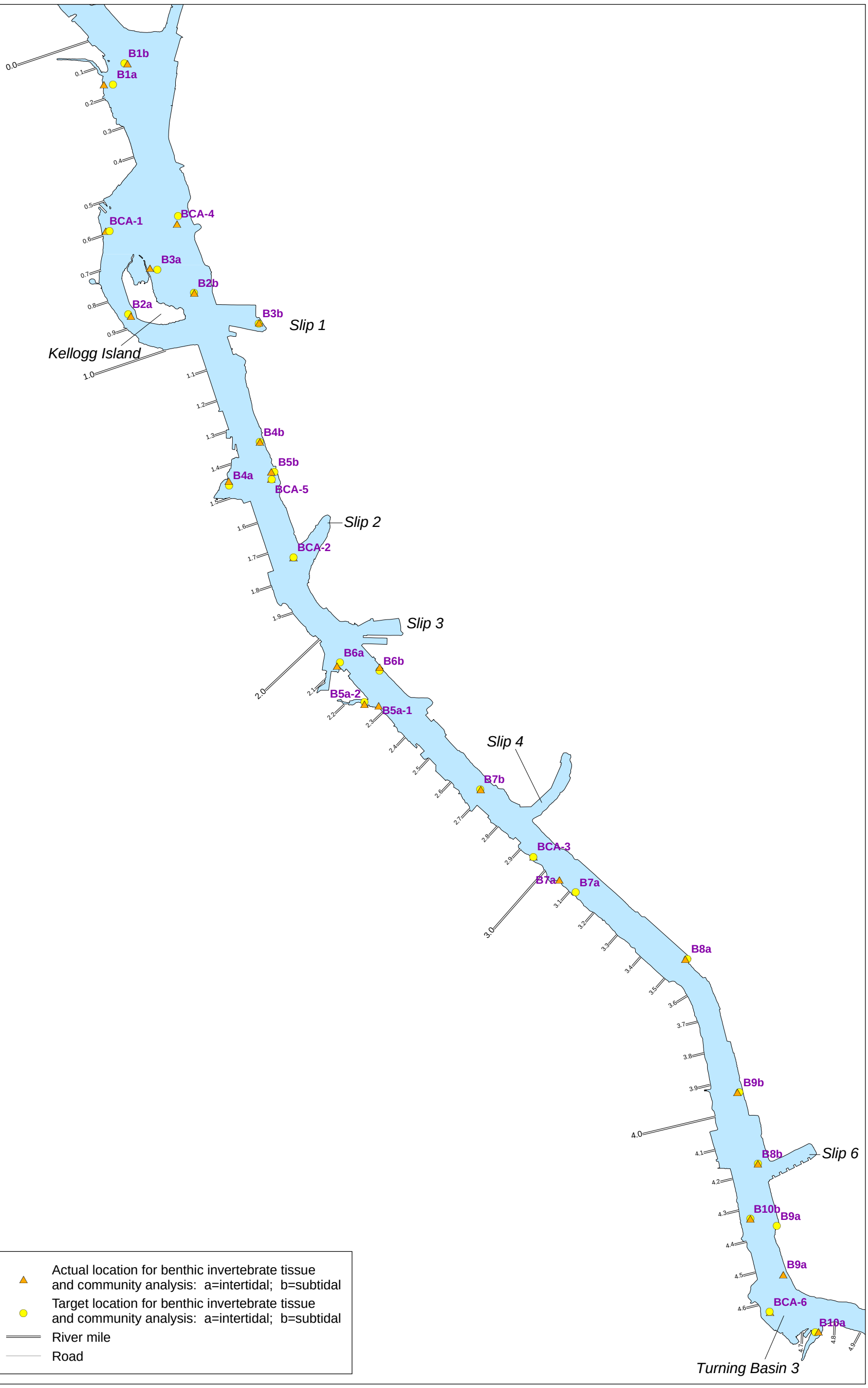

Figure 2-1. Target and actual locations for sampling benthic invertebrate tissue, communities, and co-located sediment

Prepared by STS 05/20/05 Map 1778

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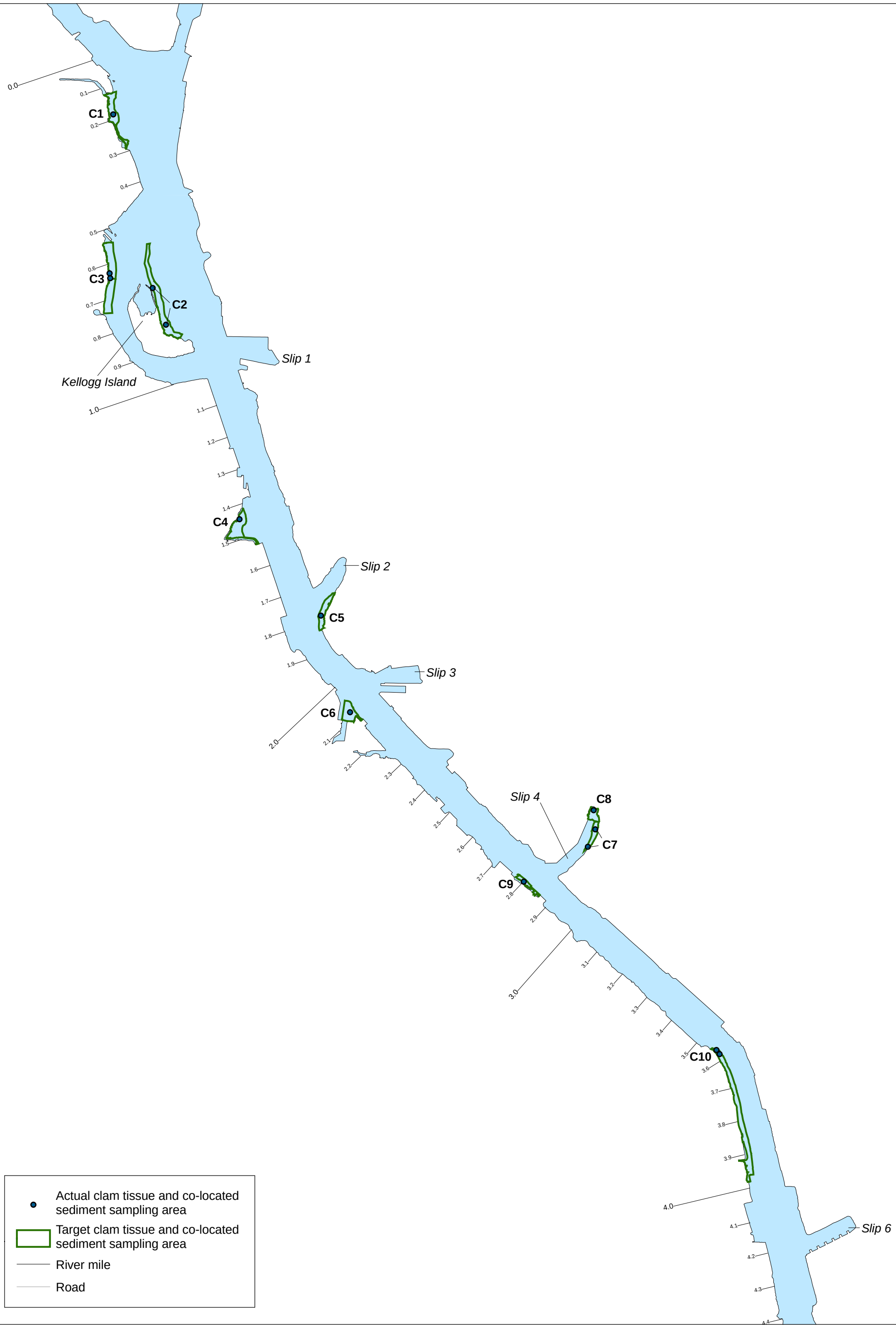

Figure 2-2. Clam tissue and co-located sediment sampling locations in the LDW

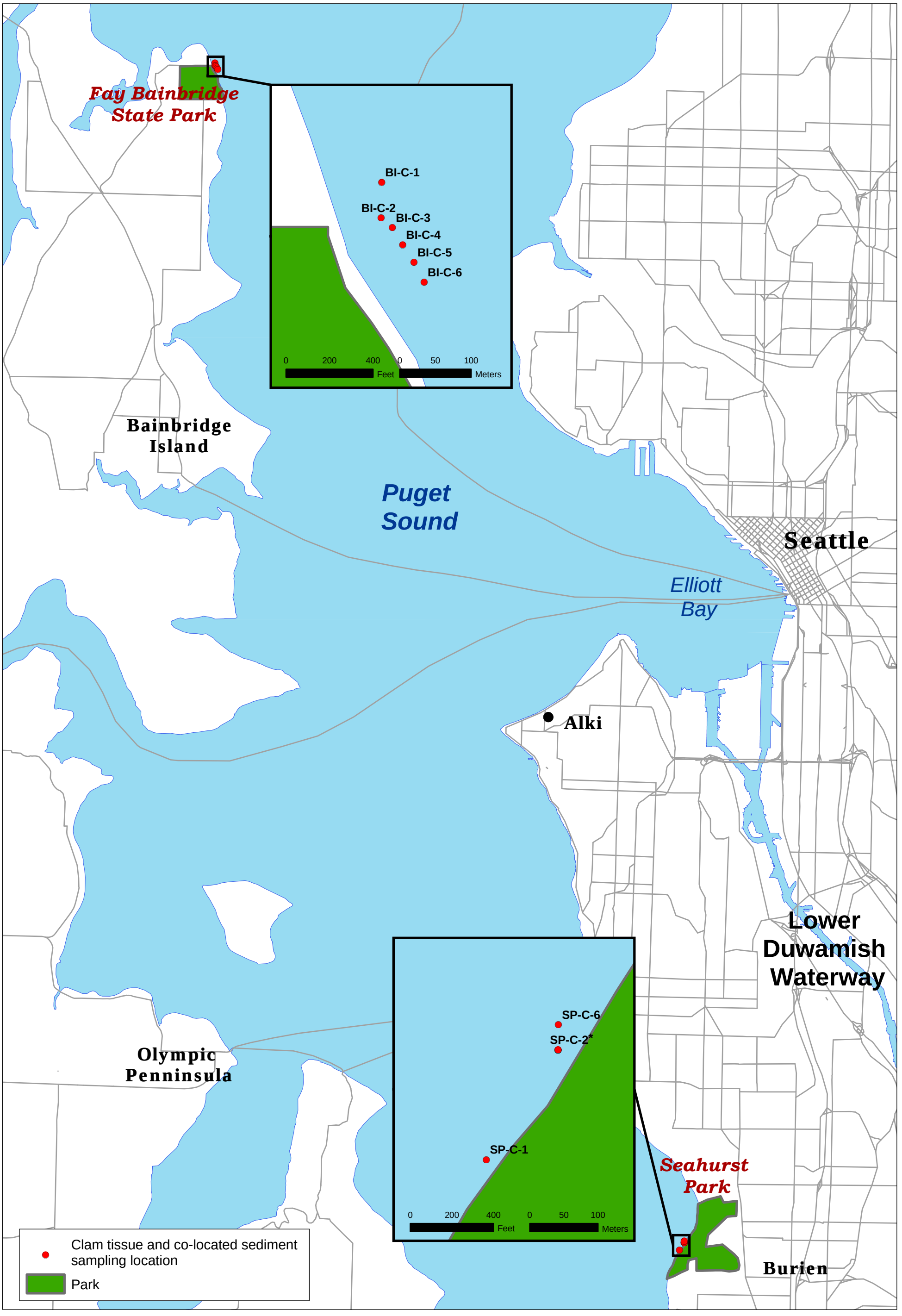

Figure 2-3. Background areas and specific sampling locations for clam tissue and co-located sediment sampling

* Four samples were taken at this location

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N

Wind Ward environmental LLC

Prepared by STS 05/23/05 Map 1614

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